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THE MADONNA OF SAN ANTONIO.

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Considerable interest has been evinced concerning the Madonna of San Antonio, which has been recently purchased by J. Pierpont Morgan, Esq., for the enormous sum of $500,000, the largest price ever paid for a single picture, a price which has only been approached by another Madonna of Raphael, which was acquired a few years ago by the British nation for $350,000. The latter picture, however, is superior in many ways to Mr. Morgan's purchase, which is not a Raphael of the first order. This brings up an interesting point; if a Raphael of second order is worth $500,000, what would the Sistine Madonna, the Madonna di Foglino, be worth? Mr. Morgan's Raphael has been on the market for many years, and was exhibited for a time at the South Kensington Museum. At the commencement of the year 1504 Raphael began this picture for the religieuses of the Convent of San Antonio of Padua at Perugia. The picture consisted of three parts, the picture proper, the central panel, the lunette, and the predella or gradino, which formed the base of the altar piece.

The principal picture is painted on wood, and the figures are two-thirds the size of life. The Infant Jesus is on the knees of His Mother, and blesses the young St. John. It is a familiar scene, which Raphael had already shown several times with variations of composition. The presence of the witnesssing saints, as well as the solemnity of the accessories, give to this subject a considerable degree of character and grandeur. St. Peter, St. Paul, St. Catherine of Alexandria and St. Dorothy are grouped symmetrically in twos at each side of the throne of Mary. The throne is painted to represent white marble incrusted with arabesques. It is terminated by a circular baldacchino. In the background will be seen some buildings, including a church, and the horizon is terminated by high mountains. As in many of Raphael's Madonnas, even the background is given over to symbolism. Several of the heads show certain defects in construction which Raphael was apt to display at times. The good people of the Convent of San Antonio had certain scruples about nude figures, and Raphael was obliged to submit to the wishes of his clients, and cut out the picturesque convention which had been permitted from the earliest Christian times, as in the Renaissance, of showing the child naked in the arms of His Mother. The infant Jesus is dressed in a blue robe. His left hand holds a portion of the drapery which covers him, and with the right hand He blesses the Precursor.

The painting is of a warm color, powerful, harmonious and varied. The flesh tints have preserved much of this original brilliancy. The picture was much neglected, and early in the last century, after the annexation of Naples and Sicily to Italy, the picture passed into the possession of a Spanish grandee.

The lunette represents the Godfather holding in his hand a terrestrial globe, with two angels at the sides, and below in the firmament are heads of cherubim. The angels have the banderoles which are so suggestive of Umbrian influence. The predella contained originally five small wings which have been dispersed. The subjects were "Christ on the Mount of Olives," "Cross Bearing," "The Dead Christ," "St. Francis" and "San Antonio of Padua."

TEN YEARS' IMPROVEMENT OF THE TELEPHONE AND TELEPHONE SERVICE IN NEW YORK.*

Mr. J. J. Carty was introduced by the President of the New York Electrical Society, and after welcoming the members of the Society to inspect the Exchange, proceeded as follows:

Ten years ago, as well as to-night, the Cortlandt Street plant was of sufficient novelty, magnitude and merit to warrant a visit from such a distinguished society as yours. But within these ten years radical improvements have been made, changes have taken place, and an almost complete transformation has been effected. Therefore, before undertaking to sketch for your information an outline of the main features of the plant which it is my pleasure to exhibit to you to-night, it will be interesting and possibly instructive if I should first call your attention to some of the important advances in telephony which have been made in this country and in this city during the last ten years, all of which are embodied in what you are to see to-night, and when you view with the critical eye of experts that which is to be exhibited I am sure that your feeling will be that in the phenomenal advance in industrial affairs which has been made by Americans, electrical developments are in the front rank, and that among these electrical developments the art of telephony has not lagged.

The opening of the present Cortlandt Street Central Office was but the culmination of a series of works planned a number of years ago and but recently completed. The common battery system, of which the Cortlandt Street office represents the highest type, was in New York first installed in Harlem more than three years ago. After a rigid demonstration of the system in that district a great many improvements were decided upon, and the switchboards of all of our offices transformed from the old magneto system to the now standard common battery plan; and to show how rapidly improvements follow one upon another I may say that before we had installed Cortlandt Street on the common battery system the Harlem office, in which it was first installed only three years ago, had outgrown its equipment, and a new building had been started for a greatly enlarged central office with improvements not known at the time the Harlem office of three years ago was installed.

At the time of its installation the first Cortlandt Street switchboard represented all that was best in the telephonic art. The switchboard was large enough to accommodate 5,000 subscribers' lines and 600 trunk lines. It was inspected and studied by engineers from at home and abroad, and was regarded as so great an improvement over what had gone before that this society met to visit and inspect it in a body. But to-day there are those young in the business who laugh at our boasted improvements of ten years ago, and we, who were responsible for its installation, find it hard to justify to-day those plans about which we then boasted so much.

I shall say a word or two about some of the significant changes which have taken place during the last ten years in this building.

Ten years ago to operate each subscriber's transmitter it was necessary that two cells of Fuller battery be provided at each telephone station. To-day in the new switchboard we are operating on the common battery plan, no battery being required at the subscriber's station, all of the battery being concentrated at the central office and taking the form of large storage cells.

Ten years ago in order to signal the central office each station was provided with a small alternating current generator operated by hand. To-day the generator is dispensed with at the subscribers' station, and the signaling is automatically performed when the subscriber takes the telephone from the hook.

Ten years ago when the subscriber had finished talking it was not only necessary that he should hang the telephone on the hook, but it was also necessary that he should give a brisk turn to the crank in order to send a clearing-out signal to the central office. To-day this is unnecessary; the act of the subscriber in hanging his telephone on the hook automatically lights a signal in the keyboard which notifies the operator to clear out.

Ten years ago, notwithstanding our numerous instructions in the telephone book and requests to subscribers that they should notify the operator to clear out by turning the generator crank when through talking, it was necessary for the operator, owing to the failure of the subscriber to remember these instructions to listen in to see whether the subscribers had finished talking, and it was not only necessary to listen in, but it was necessary for the operator to ask, "Are you through?" Unfortunately, owing to the strenuous conditions under which the then operator worked, she almost invariably reversed the order in which she conducted these operations, too often breaking in on the subscriber in the midst of his conversation, asking, "Are you through?" and then listening afterward.

It will not be necessary to enter into details on this point in order to bring vividly to your mind the conditions which I have attempted to describe. At the present time, when two subscribers have finished talking, two lamps are lighted in the connecting cords in front of the operator in control of the connection. The lighting of these lamps means that both subscribers have hung their telephones on the hooks and have relinquished control of the line. Seeing the lamps lighted, the operator is not obliged to connect herself into the line and is not obliged to ask whether the subscribers are through, but knows of necessity that both subscribers have hung up, and that the only thing for her to do is to disconnect both lines.

It is owing to this fact that one of the greatest advantages of the common battery system is realized. A substantial improvement in the service arises from relieving the operator of the duty of supervising the connections by listening in. She can now supervise visually by glancing at the condition of the lamps to see whether they are lighted or not. The operator, thus relieved of the old time supervision, can handle a much larger number of lines than formerly. Consequently fewer operators are required, and, futhermore, what is also important, fewer sections of switchboard are required. In the system of ten years ago there were 44 sections of switchboard installed upon the eighth story of this building. A new story has been added, but the floor space is identical in amount with that contained in the old story. At the present time 9,000 lines are placed in a room of the same area which formerly contained the 5,000-line switchboard, and the number of operators employed is not much greater than before. These constitute two of the important advantages of the common battery switchboard: The simplifying of the labor of the central office, and the vast improvement in the character of the service rendered to the subscriber.

In addition to these, another improvement, by no means to be neglected, has been obtained. While formerly it was necessary to maintain two cells of Fuller battery at each subscriber's station, at the present time no battery at the subscriber's station is required, all of the current being provided from a few cells, although very much larger cells, at the central office. This relieves the subscriber from the annoyance formerly occasioned by the visits of the telephone battery men to make periodical renewals of the Fuller cells, which in the case of busy subscribers took place sometimes as often as once in two months.

The idea of a common battery switchboard was not new ten years ago. Many attempts to attain such an end were made, the principal idea being, however, to avoid the necessity of renewing batteries at subscribers' stations, no thought being given to the advantages accruing in the way of operating at the central office. When finally the result was obtained it was found to the surprise of many that while the doing away with the battery renewal at the subscribers' station was accomplished, and while this was by no means an unimportant factor, nevertheless, when considered with reference to the improvement in the quality of the service rendered, it was found to be of subordinate value.

When to-night you view this modern installation you will no doubt, having in mind the Cortlandt Street of ten years ago, be impressed with the fact that a vast amount of complication has been added to the system, and I think you will find it difficult to resist the idea that the tendency to complexity which will be perceived is to some extent unfortunate. But to this I can only say that the requirements of the modern telephone exchange have become more and more exacting and that a telephone exchange located, as Cortlandt Street is, in the financial and business center of this country, has to be constructed with reference to the various complexities which there arise. There have to be considered those waves of excitement, those rushes of business, those financial panics, those concentrations of calls resulting from national celebrations, from explosions, accidents, etc., which unfortunately are so increasingly frequent in our modern civilization. To all of these influences the telephone exchange in general, and the New York telephone exchange in particular, is peculiarly subjected, and it is at these very times that the telephone is at its best. We should be derelict in our duty therefore, if we did not plan our vast and complicated system so as to stand these sudden demands which no human foresight can avoid.

Even a harmless practical joke started on its way by some wag would, unless we provided sufficient reserve power, seriously embarrass the working of our system. Not long ago a joke akin to the Tom Collins joke of old was started in New York. A practical joker would tell his friend to call up Mr. Fish at —— Broad on a matter of importance. The friend so informed would call up the number, only to be asked which Mr. Fish he wanted to talk to, because that number was at the Aquarium. For about a week this joke raged, and it took the services of a number of special operators to intercept calls for the Aquarium and flash the joke in the pan, as it were, at the central office. Afterward some minor jokers started a similar lot of calls for the Menageries at Central Park and for the Zoo in the Bronx, sending their victims to the telephone to call up Mr. Wolf, Mr. Fox, etc.

Thousands of calls a day are received from subscribers who wish to know who is the nearest subscriber to a given number on a street named. It would be more troublesome to refuse these calls than to attend to them, so that provision for handling such contingencies must be made. In New York the Saturday half-holiday has resulted in crowding into a very small space of time an enormous amount of business on Saturdays, and when a Saturday half-holiday precedes a legal holiday the rush of business is intense.

In consequence of these conditions our plans must be made on such a liberal scale that we can handle the business at the busiest periods, even when they occur at infrequent intervals. To meet these contingencies we have, in addition to installing a large amount of additional apparatus, provided a large number of special operators called monitors, whose sole duty it is to relieve the subscribers' operators of the necessity of holding conversations with the subscribers and to take the request of the subscriber, whatever it may be, and see that adequate and polite attention is given to it. All of these conditions have been taken into account in making the plans for the installation which you will inspect to-night, and to some extent account for the complexities you will observe which were not present in the Cortlandt Street of ten years ago.

But in making the comparison between the old system and the new I wish to call your attention to other conditions which, when rightly viewed, will establish the fact that after all there has been a successful movement in the direction of simplicity. It should be borne in mind that in the old system there was required at each subscriber's station two cells of Fuller battery, which would in an installation of the present magnitude amount to 18,000 cells. All of these Fuller cells have been displaced by 11 cells of storage battery of the chloride type located at the central office and occupying only 110 square feet. If the 18,000 cells of Fuller battery were assembled at the central office and arranged on racks in the most economical way they would occupy a very large space. In the old system a small alternating-current generator was required at each station. If these generators and batteries were massed at the central office they would together occupy a space almost equal to that occupied by the entire common battery switchboard itself. The total weight of the present storage cells is only about 11,000 pounds, and that of the local batteries would amount to over 216,000 pounds.

During the last ten years many improvements have been made in underground telephone cables, but the main ideas of their original construction have been adhered to. Dry cables have taken the place of filled cables, paper has entirely displaced cotton, and the improvement has been in the direction of placing a large number of pairs of wires in a given lead sheath. Cables of 200 pairs are now the rule where formerly only 50 pairs were used.

A vast amount of detail in construction and engineering has been worked out, and Mr. J. C. Rennard, our assistant chief engineer, who has carried on the practical engineering work of the New York installations, will describe to us many features of interest.

The installation in all of its parts has been constructed by the Western Electric Company, which was the concern which installed the old Cortlandt Street board, and which as much as any other single agency has contributed to the forward condition which the art of telephony has attained not only in this country, but abroad.

Nearly all branches of electrical engineering have been drawn upon in making this telephone installation, and to deal exhaustively with even one of the important details of the work would take up the entire time of the meeting.

While the main object of the visit of the society was to inspect the actual working of the central office plant and therefore the time allotted for preliminary description was restricted, Mr. Rennard's concise and instructive remarks were listened to with careful attention and appreciation. After outlining in a general way the various features of interest which were to be shortly viewed by the members, Mr. Rennard gave an outline sketch which was of the greatest interest to the large number of engineers present. His talk was illustrated by diagrams of circuits, and a number of suggestive details and interesting statistics were given. Among other things, he stated that the Cortlandt Street installation required for its operation 13,875 miniature incandescent lamps, which, so far as numbers are concerned, would represent a fair-sized central station; when considered from the standpoint of energy consumed, of course the comparison did not hold good, the total amount of energy available and needed for the operation of the central office for all purposes being 75 kilowatts. In the switchboard itself over 469,000 spring jacks are installed, being connected together and to the other parts of the apparatus by over 400,000 feet of cable containing more than 25,000,000 feet of wire. The

* Abstract of an address before the 221st meeting of the New York Electrical Society by Mr. J. J. Carty, at the Cortlandt Street Telephone Building, New York, February 15, 1902.

switchboard itself has a capacity for 9,600 subscribers' lines and more than 15,000 stations.

After Mr. Rennard's interesting remarks were concluded the members of the society were taken through the central office in groups guided by details from the chief engineer's staff. So interested were the members in viewing the installation that they remained until a late hour enjoying a most interesting and profitable evening.

THE POLAR RAYS OF THE CORONA.

By MRS. WALTER MAUNDER.

THE corona of 1901 was of the most pronounced minimum type, its form was simpler than any of which astronomers have had experience since 1889. This circumstance, though it may seem to detract from its beauty and interest in some respects, is not without its advantages, as the relations of many of its details can be more distinctly followed and their significance better appreciated.

Especially is this the case with regard to the structures immediately round the two poles of the sun's axis. At times of maximum, the great synclinal rays are found, not merely in the neighborhood of the sun's equator, but all round the limb, and the polar rays are obscured by the more conspicuous type of formation. But in an eclipse like that of last May, the polar regions are left absolutely free except for the beautiful and regular tufts of light which have earned for themselves the appropriate name of "plumes" or "panaches." These are then seen there in utmost distinctness, and can be studied to greatest advantage. No doubt structures similar in general character may exist in every region of the corona, both at minimum and maximum, but in the equatorial regions the greater brightness of the great synclinal curves, and the complexity shown by the regions of the corona close to the sun's limb, prevent the "plumes" from being easily recognized.

Restricting our attention for the present to the rays round the southern pole, they present something like the following appearance. Starting from the great southeast synclinal group, we find that the first polar rays are drawn over into a curvature which nearly, though not precisely, conforms to the southern outline of that formation. As we approach the pole the rays are less and less curved, till at the pole itself, and in its immediate neighborhood, we find them as straight as if they were ruled. And this change of shape is not confined to the bright rays. Between the bright rays there are dark streaks—whether we regard them as mere rifts or interspaces, or as actually dark rays, having an objective existence, as being, in other words, an absorption and not a mere contrast effect—showing precisely the same excessive curving near the southeast synclinal group, and straightening gradually as they approach the pole until they become there as truly rectilinear as the bright rays among which they are found. Proceeding from the pole toward the west, we find in like manner that the curvature of the rays increases the further we get from the pole, although we do not get the same extreme bending noticed on the east. But it is noteworthy that the southwest equatorial wing is more diffused than the southeast; its outline is not so sharp and well defined, and the curve of that outline is much gentler, except at one particular point with which I am not at present concerned.

The dark rifts or rays interspersed between the bright polar rays deserve special attention. Many of these appear to be, and probably are, mere contrast effects, interspaces between the bright rays. But others seem to me to be of quite a different order. Thus on the east of the pole we find two bright rays, the curvatures of which lead them apart from each other the further they recede from the sun. The dark space between them therefore broadens the further we go from the limb. But within this space we find an intensely black line; not a contrast effect, for it borders neither of the bright rays, it does not broaden as it recedes from the sun, but is equally narrow throughout, and its curvature corresponds to that of neither of the bright rays between which it runs. More remarkable still it can be traced further from the sun than the bright rays. A similar remark applies to another ray even longer and darker than the first, that springs almost exactly from the sun's pole.

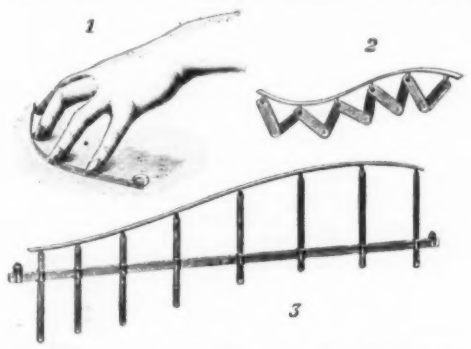
The polar rays toward the west appear to show some evidence that they are not in the same plane. To the extreme west two short bright rays of considerable curvature appear to be distinctly nearer to the spectator than a pair of straight rays which make a considerable angle with the solar axis. The more westerly of the pair would indeed seem to be partly hidden by the curved rays; the more southerly in its turn appears to conceal the lower portion of three straight rays, which show a slighter divergence from the solar axis. Elsewhere in the corona of 1901 there were similar indications, none very strongly marked, of a certain amount of relief. The general effect of this corona, as of all coronæ, is of that of an essentially plane phenomenon. The impression produced is that of a superficies, not of a solid; of a body having extension in two dimensions, not in three.

Yet we know for a certainty that the material composing the corona must be distributed in all three dimensions; taking one eclipse with another it must on the average be equally extended in all solar longitudes. We are looking down upon the sun day by day through a depth of the corona which on the average corresponds to its mean depth as seen in the tangential plane.

This consideration is so certain that it has led to the system of polar rays being regarded as in fact a sub-polar ring, the pole itself being bare. But at a distance from it of about 20 deg. or 25 deg. a number of rays rise from the surface and all of them bend over toward the sun's equator. On this theory, those rays which lay very nearly in the line of sight would necessarily appear to us to be straight or nearly straight, through the effect of foreshortening, and would be seen by projection in the apparent neighborhood of the pole. It has been further suggested that this ring of rays would be a phenomenon essentially similar to our terrestrial auroræ, the long coruscations of which have frequently impressed themselves upon observers as resembling in appearance these polar rays of the corona. But indeed this latter suggestion is a very superficial one, and entirely ignores the difference between the positions of the spectator in the two cases. In the case of a terrestrial aurora we may indeed see the rays shooting up from low down in the north, high across our zenith, but we have no guide by which we can tell as to whether those rays are really rising or falling in our atmosphere, or as to whether, which is far more probable, they are moving practically at one given level; their apparent rise or fall being simply the effect of perspective. So far as our knowledge goes a terrestrial aurora, watched from the moon, would seem to be essentially a surface phenomenon; as entirely so as the streaks which radiate from Tycho or Copernicus appear to be to us.

The difficulty which we have in regarding the polar rays as situated in a ring at about 65 deg. of solar latitude lies here; that in such a case they should obviously be much more crowded together as we approach the greatest apparent distance east and west from the pole, while near the pole they should be considerably shorter and fainter, and much more sparsely scattered. In other words, not only would there be a marked flattening of the corona itself at the two poles, but the polar rays would show such flattening among themselves. But in general these features are just what are not seen. The straight rays close to the pole are in general at least as long and as bright as those nearest the synclinal groups, and they are nearly, if not quite, as closely packed. Yet a careful examination of the region before us does show a certain crowding toward the east, while close to the great dark ray at the pole a broad but short bright ray is clearly seen, which may very well have its rise in a latitude some 15 deg. or 20 deg. from the pole, either on the side of the sun nearer to us, or on that more remote.

The indications of relief in the corona, which the present plate affords, slight though they may be, are of importance, as they tend to remind us that the corona, in spite of that essentially flat appearance which it generally presents, must in reality have a great extension in the line of sight. It is a fact of which we need to be reminded, since it is so easy to forget it, and it has often been ignored in discussions upon its structure and nature. And indeed it seems very difficult to reconcile it with some features of its actual appearance. The dark rays, for instance, whether we regard them as mere interspaces between bright formations, or as having a distinct and separate objective existence, are exceeding hard to account for in a structure in relief. Then, again, in the coronæ of 1900 and of 1901, and we might add also in the more complicated one of 1898, the great mass of the corona was comprised in a very few striking formations of the character known as synclinal groups. In 1900, three of these were recognized; in the other two years, four On all three occasions these structures had the most enormous extension, reaching on the average a distance of about three solar diameters from the center of the sun. It is clearly not conceivable either that the structures which were visible were exactly where they appeared to be, in a plane at right angles to the line of sight, or that the moon concealed from us at the most more than two or three structures of similar character and extent. The picture, therefore, that is conjured up to our mind of what would be visible to us, could we look down upon the sun and see the corona on all sides at once and in full relief, is that of about half a dozen or so of these monstrous excrescences distributed irregularly round the sun; while about one-tenth of the solar surface, that immediately surrounding the two poles, would be given up to a few "plumes," few, that is to say, relatively to the area engrossed by them.—Knowledge.



FLEXIBLE RULERS FOR DRAWING CURVES.

APPARATUS FOR DRAWING CURVES.

WE illustrate herewith, from La Nature, three types of flexible rulers for drawing curves, the invention of a Mr. Brooks, of London.

One of these is made entirely of celluloid, and is provided laterally with five small rings upon which to rest the fingers when the ruler is placed vertically in order to make a drawing. It will be seen that, owing to these rings, it is possible with one hand to keep the ruler at any degree of curvature whatever, while the other hand is manipulating the drawing pen or pencil (Fig. 1).

Fig. 2. shows a similar but somewhat more complicated ruler, which is here a flexible band of steel, to which, through rings, are laterally attached a series of flat links, the relative position of which determines the curves of the ruler. The joints of these links work by hard friction, so that after any curve whatever has been given the ruler the latter keeps it until the effort necessary to modify it is made. There is thus obtained a genuine templet that permits of drawing two symmetrical curves, one on each side of the same axis.

The third type of apparatus (Fig. 3) is still more complicated. Here the ruler is in most cases of wood, because it is of larger size and does not need to be so flexible. Through joints it is attached at a series of points to square metal rods that are capable of sliding in metal sockets, so as to form more or less marked concavities or convexities in the strip of wood. The sockets, morever, are fixed upon a straight metal rod that forms, as it were, the frame of the instrument, and permits of drawing a curve on either side of a horizontal axis. As in the preceding case the apparatus may be reversed for the drawing of a symmetrical curve.

RAILWAY MOTOR CAR SERVICE IN EUROPE.

UNDER date of January 1, Thornwell Haynes, United States Consul at Rouen, writes as follows regarding Railway Automobiles in Europe:

Railway automobiles are beginning to be considerably used in Europe: (1) As early and late postal trains; (2) on branch lines and others where passengers are few; (3) on trunk lines where it is often difficult to secure convenient secondary trains; (4) in industrial centers and city suburbs. Furthermore, the automobile railway train can be attached for a certain distance to an express and detached at the station where the road branches.

There is an economy in the personnel of the train, in the expense of traction, in material, capital, and maintenance, and an additional traffic because of the increased number of stations made possible by the facility of stopping and starting. Up to the present time, the carriages constructed are steam and electric.

Of the former, I have noticed mention of the following: The Belgian State Railway has constructed carriages 46 feet long weighing 50 tons, with a capacity of 53 passengers. They can go at the rate of 18½ miles an hour, or a maximum rate of 34 miles an hour. Two men are generally in control; sometimes three. There are also employed in Belgium two Rowan coaches for tramway service in the suburbs of Antwerp. They have 46 places, weigh when charged 4000 pounds and have a speed of 31 miles. The boiler is vertical, with inclined tubes. It is the same automobile used on the lines of the Paris Omnibus Company. The Russian State Railway (Nicolas line) employs two steam coaches. These are constructed with two stories having 20 places for first-class, 20 for second-class, and 40 for third-class passengers. The management necessitates three men, and the maximum speed is 14 miles an hour. They burn naphtha, and the boilers have horizontal tubes. The Northern Railway of France has put on its lines a postal steam automobile, with room for 12 persons in the back part of the coach.

The following trials have recently been made in Europe with the electric automobile:

The Italian Mediterranean Railway has placed automobiles on the line from Milan to Monza. Each carriage has room for 90 passengers, of whom 16 can be seated. It goes at a rate of 27 miles, and is recharged after each 50 miles. The French Northern Railway Company, at the same time when the steam automobile mentioned above was constructed, built an electric automobile weighing 20 tons, having room for 12 people, a speed of 30 miles, and being capable of going 74 miles without recharging. The Belgian State Railway has put in service 5 carriages for tram service without baggage. Each of these has 78 places, weighs 51 tons, and can make from 62 to 93 miles, with stoppages every 3 miles, at a speed of 19 miles an hour.

CALCAREOUS CLAY AGGLOMERATES PREPARED BY M. MEURER.

M. MEURER describes a rational method for obtaining silico-calcareous bricks of good quality. This consists in the following operations:

1. Drying and heating of sand employed.
2. Working up pulverized quicklime with hot sand, (quenching by addition of hot water under pressure) finely divided and in quantity chemically sufficient to obtain hydration.
3. Second addition of hot water, distributed and proportioned in the warm mixture so as to aid the molding.
4. Molding by the press, in the course of which the hygroscopic water disappears completely by evaporation.
5. Hardening of the product obtained by keeping it in steam, saturated or superheated at high pressure.

This invention realizes a scientific and rational manufacture. It is a process which involves no uncertainty, nothing unexpected, and which allows us to obtain industrially at a low price, certain products, at the same time that it allows the employment of a restricted mechanical material.

The two substances employed are sand and lime. Now M. Girard, the well-known chemist, has discovered that crude clay, like sand, undergoes the action of lime in steam under pressure.

Indeed, by acting on a mixture of lime, clay and sand, M. Girard has ascertained that the clay is combined with lime to such a point that it is completely transformed, and on analysis, after treatment, only hydrosilicates of lime, of aluminium and of iron perfectly soluble in chlorhydric acid, are found.—Translated from La Revue des Produits Chimiques.

METHOD OF KILLING ANIMALS AT PARIS POUND.

A LETHAL chamber for the destruction of lost dogs has been provided for the Paris pound. Thirty condemned dogs are placed in a cage, which is rolled onto a platform, which, by hydraulic force, sinks about six feet into the earth and is hermetically closed. Carbonic-acid gas is turned on and in the space of forty seconds every dog dies without a struggle. By the old system—the use of common gas—the dogs suffered for sometimes two and three minutes.

In the London pounds, an admixture of carbonic-acid gas and chloroform is used, but it was decided here that as carbonic-acid gas is one of the most powerful anæsthetics known, the chloroform was superfluous. The cost of this lethal chamber was almost 10,000 francs ($1,930).

In the pounds of some of the cities in the United States, electricity is used for the destruction of the dogs. While this causes instant death, only one dog can, as I understand it, be killed at a time.

[Continued from SUPPLEMENT No. 1365, page 21870.]

THE NAMING OF OUR WAR VESSELS.

AT the close of the civil war the United States had on its hands a miscellaneous collection of vessels, which had been bought, built or purchased for that great struggle; some were good, but the majority were either bad or indifferent. Very few new vessels were added from year to year, and those in commission or in ordinary deteriorated so rapidly that just before the commencement of the new or steel navy our warships were the laughing stock of the world, commanding no respect abroad and but little at home, a disgrace to the Republic. In 1883, however, the United States again began to prepare for war in time of peace, and the "Dolphin," "Chicago," "Boston" and "Atlanta," known as the "Roach ships," on account of John Roach & Sons having secured the contract to construct them, were authorized; thus began the navy of to-day—a navy which for efficiency will in a few years rank among the best and greatest the world has ever known.

The selection of names for vessels in the United States navy has become during the last ten years a matter of more than minor consequence, and one requiring more thought and judgment than most people imagine. Intense rivalry exists between States and cities as to the size and character of the vessel to receive their name. Notwithstanding that Congress has by various acts regulated the sizes and types that are to be named for States, cities, rivers, etc., the Secretary of the Navy is compelled to exercise great care in selecting a name in order that he may not "tread on some one's toes." Political and historical circumstances must be considered, and they really decide the course to be pursued. An illustration of the rivalry that exists has recently become public property, in the case of Connecticut and Rhode Island; a single-turreted monitor now building had been named the "Connecticut." This caused very little dissatisfaction until the latest battleships were authorized and one received the name "Rhode Island;" then trouble began. It was impossible for Connecticut to understand why her name should be given to a vessel of the monitor type, one-fourth the displacement of the battleship named for her neighbor, Rhode Island, when in size she was four times greater, with over twice the population of her sister State. She was equally puzzled if historical reasons were given, for was she not settled three years in advance, and while both States were included in the original thirteen, did she not ratify the Constitution two years prior to her neighbor? Was she not in many other respects superior to the smallest State in the Union? Therefore she felt obliged to withdraw her name from the vessel to which it had been given and wait for an opportunity to bestow it upon a vessel at least as large as that honored with Rhode Island. This course was pursued by the Navy Department, and the monitor which was to be called "Connecticut" was known for a time as Monitor No. 8, but later was renamed "Nevada." This is but one illustration of the difficulty experienced in selecting names and the necessity for great care and good judgment in awarding them. During the terms of Secretaries Chandler and Whitney the regulations governing the nomenclature of vessels of war for the United States were followed as closely as one could be guided by obsolete requirements. It remained, however, for Secretary Tracy to call attention to the fact that ships and guns had changed since 1819, and that the old regulations were no longer applicable to modern ships, and to suggest a remedy in his report to Congress in 1889. In this report he says: "The laws relating to the manning, rating and command of vessels (Revised statutes, sections 1529 to 1531) should be amended to conform to modern conditions. The classification in the statutes relates to types of thirty years ago, and not only does not apply, but is impossible of application, to modern ships. According to section 1530, which prescribes the ratings, steamships of forty guns or more are classed as first-rates; those of twenty guns and under forty, as second-rates; and all those of less than twenty guns, as third-rates. We have not now, nor are we likely ever to have, a first-rate ship, as described by that statute, and it is doubtful whether such a vessel can be said to exist in any of the navies of the world. The only classification which can properly be applied at the present day is that on the basis of displacement. . . . It is therefore recommended that the law be repealed and that the warships of the navy, of whatever type, be hereafter classified as follows: First-class of 5,000 tons displacement and over; second-class of 3,000 or more and below 5,000; third-class of 1,000 or more and below 3,000; fourth-class under 1,000 tons. It is recommended that the following rule be adopted for the naming of vessels: Battleships after the States of the Union; cruisers, after cities; coast defenders, armored, after important events or names connected with the history of the United States; unarmored, after rivers of the Union. Vessels of special classes should be given names appropriate to the service for which they are intended." One branch of Congress acted upon the suggestion, but for some unknown reason the other branch failed to concur, and the regulations remain unchanged to-day except for the addition under date of May 4, 1898, which provides that "hereafter all first-class battleships and monitors owned by the United States shall be named for the States, and shall not be named for any city, place, or person until the names of the States shall have been exhausted; provided, that nothing herein contained shall be so construed as to interfere with the names of States already assigned to any such battleship or monitor." The latest system of nomenclature seems to be for battleships, armored cruisers and monitors to be named for States; protected cruisers for principal cities of the Union; other cruisers and gunboats for cities of the United States; torpedo-boat destroyers and torpedo boats for distinguished deceased naval officers; submarine torpedo boats, names appropriate to their class; tugboats, usually Indian names; and special classes are given special names believed to be appropriate to their duty. During the Spanish-American war the navy was suddenly increased by the addition of from about sixty to one hundred auxiliary vessels of all kinds, shapes and sizes which received new names. It is possible some system was followed in awarding these names, and a glance in the register will show that the whole gamut of Roman, English, American, Indian, mythological, poetical and sentimental was run in order that none should be missed and nobody offended. We should not be surprised, however, that such a miscellaneous aggregation of names should creep into the navy at a time when guns and men were more to be considered than names for vessels. At the close of the fiscal year 1901 the total number of vessels, good, bad and indifferent, in the navy of the United States was 307, and usually when the name of one of these vessels is mentioned it merely calls to mind location; the significance and derivations of the name are seldom referred to, if known. To attempt to give the history or derivation of each of the 307 vessels in the United States navy would require too long an article; a few, however, will be given.

SELECTED	ORIGINAL STATES.	CHART OF DISPLACEMENT.		BATTLESHIPS	ARMORED CRUISERS	MONITORS	PROTECTED CRUISERS	CRUISERS	GUNBOATS	TOTAL DISPLACEMENT IN TONS.
	CONNECTICUT		1					HARTFORD		2790
	DELAWARE		1						WILMINGTON	1689
●	GEORGIA		2	GEORGIA			ATLANTA			19473
●	MARYLAND		4		MARYLAND		BALTIMORE		ANNAPOLIS CHESAPEAKE	23014
●	MASSACHUSETTS		4	MASSACHUSETTS			BOSTON	HARTFORD	CONCORD	18632
	NEW HAMPSHIRE		2	KEARSARGE		MONADNOCK				16910
●	NEW JERSEY		3	NEW JERSEY			NEWARK		PRINCETON	22013
	NEW YORK		3		NEW YORK BROOKLYN		ALBANY			22829
	NORTH CAROLINA		1				RALEIGH			3462
●	PENNSYLVANIA		2		PENNSYLVANIA		PHILADELPHIA			20443
●	RHODE ISLAND		2	RHODE ISLAND					NEWPORT	17421
	SOUTH CAROLINA		1				CHARLESTON			10700
●	VIRGINIA		2	VIRGINIA					YORKTOWN	18214
	OTHER STATES.									
●	ALABAMA		2	ALABAMA				MONTGOMERY		14405
●	ARKANSAS		1			ARKANSAS				3466
●	CALIFORNIA		3		CALIFORNIA	MONTEREY	SAN FRANCISCO			23849
●	COLORADO		2		COLORADO		DENVER			18638
●	FLORIDA		1			FLORIDA				3466
	IDAHO		0							
●	ILLINOIS		2	ILLINOIS			CHICAGO			17443
●	INDIANA		1	INDIANA						11403
●	IOWA		2	IOWA			DES MOINES			15945
	KANSAS		1						TOPEKA	2390
●	KENTUCKY		1	KENTUCKY						12905
	LOUISIANA		1				NEW ORLEANS			4001
●	MAINE		4	MAINE		KATAHDIN*			CASTINE MACHIAS	18319
○	MICHIGAN		1					DETROIT		2920
	MINNESOTA		1				MINNEAPOLIS			8878
	MISSISSIPPI		1						VICKSBURG	1128
●	MISSOURI		2	MISSOURI			ST LOUIS			24200
	MONTANA		1						HELENA	1689
●	NEBRASKA		1	NEBRASKA						16293
●	NEVADA		1			NEVADA				3466
	NORTH DAKOTA		0							
●	OHIO		4	OHIO			CLEVELAND CINCINNATI		MARIETTA	21620
●	OREGON		1	OREGON						11719
●	SOUTH DAKOTA		1		SOUTH DAKOTA					15138
	TENNESSEE		2				CHATTANOOGA		NASHVILLE	5220
●	TEXAS		2	TEXAS			GALVESTON			10270
	UTAH		0							
	VERMONT		1						BENNINGTON	1764
	WASHINGTON		2				OLYMPIA TACOMA			10102
●	WEST VIRGINIA		2		WEST VIRGINIA				WHEELING	16308
●	WISCONSIN		2	WISCONSIN			MILWAUKEE			23271
●	WYOMING		1			WYOMING				3466
	TERRITORIES.									
	ALASKA		0							
	ARIZONA		0							
●	DIST. OF COLUMBIA		1				COLUMBIA			8442
	NEW MEXICO		0							
	OKLAHOMA		0							
	HAWAIIAN Isl.		0							
	PHILIPPINE Isl.		21						21	3610

* KATAHDIN = HARBOR DEFENSE RAM

○ MICHIGAN = IRON VESSEL OF 685 TONS, BUILT IN 1844

The "Maine" and the "Texas" were the first armored ships of the new navy and were latterly classed as second-rate battleships. The "Texas" was built from designs purchased from the Barrow Shipbuilding Company of England, and the "Maine," which very closely resembled the Brazilian armored vessel "Riachuelo," from designs prepared at the Bureau of Construction and Repair, Washington, D. C. These vessels were each built in a navy yard; the "Maine" at New York and the "Texas" at Norfolk, Va. Sentiment to a certain extent determined the naming of these vessels, and the North and the South were considered and honored in the selection; Maine being the most northern and Texas the most southern State of the United States at that time. The origin of the name Maine is not exactly clear, some writers claiming that the name Mayne was given to the land extending from the Piscataqua to the Kennebec, in a royal grant to Gorges in 1629, in honor of Henrietta Maria, wife of Charles I., whose patrimonial estate as a princess of France was the Province of Mayne; others claim that the word applied to the *mayne* land of New England in contradistinction to the islands thereabout. Twice has the "Pine Tree State" been honored by vessels of the United States navy bearing its name. The ill-fated vessel which was destroyed in Havana Harbor in 1898 being the first, and the new "Maine," so named to perpetuate the memory of the first, now building at Cramp's shipyard, Philadelphia, Pa.

Texas received its name from a small tribe of Indians that inhabited a village within its borders, called "Tehas," meaning "friendly." The territory occupied by the "Lone Star State" originally formed a State of Mexico, up to 1835, when a rebellion started which eventually brought on a war between the United States and Mexico. The Republic of Texas existed from 1835 to 1845, when she was annexed to the United States. These two names, Maine and Texas, are very closely connected with two wars which have added very materially to the prestige and territory of the United States of America. Texas by her rebellion brought on the Mexican war, and the destruction of the "Maine" in Havana Harbor undoubtedly was one of the causes of the Spanish-American war.

The "Indiana," "Massachusetts" and "Oregon" were known as battleships Nos. 1, 2 and 3, and were the first first-class battleships authorized by Congress for the "new navy." Sentiment was again displayed in the selection of these names. The extreme East, the Lake States and the Far West were honored. These vessels were all of the same class, built from the same design prepared at the Navy Department, and when completed were considered as efficient and powerful if not more so than any vessels of any navy in the world. One of this class, the "Oregon," made a lasting reputation for herself by her trip twice around the Horn, and her participation in the battle of Santiago; unfortunately for the "Indiana," she was not in the midst of that battle, and the "Massachusetts" was away coaling.

The name Indiana, or "land of Indians," comes from the word Indian, and was first applied in 1768 to a grant of land north of the Ohio River, obtained by a company of traders from the tribes occupying this territory. Massachusetts, meaning "blue hills," is from the Massachusetts tribe of Indians, who inhabited the land about where the State now stands, at the time of its discovery. Two former vessels of the navy have borne this name, one of 765 tons, built in 1848, transferred to the War Department and renamed "Faralones," and sold in 1866; and one of 2107 tons originally called "Passaconaway."

The name Oregon comes from the former name of the Columbia River, Orégano, Spanish for "sage," great quantities of which grow along its banks. The navy has had but one other "Oregon," a small sailing vessel of 250 tons purchased in 1841 and sold in 1845. The only battleship authorized by act of July 19, 1892, was named "Iowa;" this word seems to have sprung from a Siouan tribe of Indians who lived on the Des Moines River and called itself Pajoha, or "gray snow," but to which neighboring tribes gave the name of "Ainowe" or "Iaway," and which was further corrupted when the Territory was organized in 1833 to Ioway; its true

meaning may never be known. In 1894 the historic "Kearsarge" was wrecked on Roncador Reef, and to continue this name made famous in 1864, the next naval appropriation bill passed by Congress authorized the construction of two battleships, one of which was to be named "Kearsarge;" the other or sister ship was named "Kentucky;" at this time it might be well to note a peculiar circumstance in reference to the launching of these vessels; both were launched on the same day; the "Kearsarge," although named for a mountain in a *prohibition* district, was christened with champagne, while the "Kentucky," named for an "Old Bourbon" State, was christened with water. This latter was very much against the "grain" of the Kentuckians attending the launching, and in order that the ship bearing the name of their great commonwealth might receive a *proper* christening, they armed themselves with small flasks of good old whisky, and as the great ship gracefully slid down the ways, a perfect avalanche of flasks were broken on her sides, probably the most thorough christening ever received by any warship of the world. The next Congress authorized the building of the "Alabama," "Illinois" and "Wisconsin" class, which in general design very closely resembled the two former vessels mentioned. Sentiment determined the names "Kearsarge" and "Alabama," the object being to honor a State and at the same time have in the navy of a reunited republic ships with the same names that thirty-two years before were pitted against each other in deadly conflict; names that now fight for the same flag and country. The "Kearsarge" was named for Mount Kearsarge, an elevation of about 3,250 feet in the State of New Hampshire, and is of Indian origin, meaning Pine Mountain. Most of these vessels' names are of Indian origin; thus Kentucky is from the Iroquoin word "Kenlâke," meaning "at the prairie land;" Alabama translates to "Here we rest;" Wisconsin, properly spelled in the Indian dialect Ouisconsing, meaning "beaver lodge river," received its name from the largest river in the State. Illinois is a combination of Indian and French, "Ilini" being the Indian word for man or individual, to which the French added their plural suffix "ois," making the word Illinois, meaning "tribe of men" or "land of men." The other battleships now building for the United States are the "Missouri," "Ohio," "Virginia," "Nebraska," "Georgia," "New Jersey" and "Rhode Island;" of these names three are of Indian origin, viz: Missouri, named for the Missouri River, is made up of two parts, "Mis" (Algonquin) meaning great, and "Souri" (Sioux) meaning muddy, the English translation being "big muddy" (river); Nebraska, the Indian name for the Platte River, meaning "shallow water" or "water valley;" and the Ohio, also a river, from the Iroquoin word Ohéo, meaning beautiful. Three of the names are of English origin, viz: Virginia, named by Queen Elizabeth in honor of her unmarried state (1584) at the time the territory was discovered by Sir Walter Raleigh; Georgia, named in honor of George II. of England; and New Jersey, the territory which now comprises this State, which when wrested from the Dutch by the English was granted to Lord John Berkley and Sir George Cartaret in a conveyance stating that it was to be called "Nova Cæsaria" or New Jersey in compliment to Cartaret, who had defended the island of Jersey against the Long Parliament. On the 13th of January, 1644, the General Court of Elections for the territory now comprised in the State of Rhode Island passed a resolution stating that the "Island called Aquethneck shall be called the "Isle of Rhodes, or Rhode Island;" but the colonial records give no clew to the reasons. Other authorities have claimed that the word was of Dutch origin, "Roode" or "red" on account of the reddish hue of the clay banks. The Narragansett Indians gave to the island the name "Aquidneck," meaning "peaceful isle."

The armored cruisers "New York" and "Brooklyn" were named for the two principal cities of the State of New York, but the six armored cruisers authorized under acts of May 3, 1899, and June 7, 1900, instead of receiving names according to the same rule, were named for States, and it is reasonable to presume that this course will be pursued in the future in the naming of armored cruisers, until the State names have been exhausted; thus the navy under the foregoing acts added to its list the names Pennsylvania, meaning "Penn's woods;" Colorado, from the Spanish meaning "muddy;" Maryland, called "Terra Mariæ" (Mary's land) by Charles I, in honor of his queen Henrietta Maria, daughter of Henry IV. of France; South Dakota, which received its name from a tribe of Indians, meaning "Allied," and which alludes to the great confederacy of Northwest tribes inhabiting this territory; West Virginia, same as for Virginia, of which at one time it was a part; and California; this name has been traced by Hale, in 1882, to that given the territory now comprising the state and the peninsula of Lower California, by Cortez, and was based on the romance "Las Sergas de Esplandian," published in 1510 by Garcia Ordoñez de Montalvo. In this story a pagan queen Calafia, living in the kingdom of California, furnishes an army of Amazons to Esplandian, Emperor of the Greeks, to aid in defending Constantinople from the infidels. The territory governed by Calafia was noted as an island rich with gold, diamonds and pearls, and Dr. Hale believes that Cortez, in whose thoughts gold was uppermost, gave to his new discovery this name, believing the "yellow metal" could be found in abundance. Others claim the name is of Indian origin, meaning the "sandy plain beyond the water." The single-turreted monitors now building were also named for States, and the choice fell to Arkansas, Florida, Wyoming and Nevada.

Arkansas is from the Indian "Kansoos," with the French prefix "ar," meaning "bow Indians;" Wyoming is a name carried to the West by emigrants from the Wyoming Valley of Eastern Pennsylvania; in its native location it is derived from the Indian (Delaware) and means "great plain;" Nevada is from the Spanish name given the mountains in that State, "Serrado," meaning "tooth-shaped," and "Nevada," meaning "snowy" or "snowy tooth-shaped mountain." Florida is also of Spanish origin; the name was given by Ponce de Leon in honor of his discovery, he having landed on the shores of the New World on Easter Sunday, 1513, which was called by the Spaniards Pascua Florida, or "Holy day of Flowers." Thus are the names of the battleships, armored cruisers and monitors accounted for, but to continue to describe the origin and significance of each of the 307 vessels in the navy of to-day would consume too much space. Many of the cities for which vessels are named originate from names of individuals and each has a history. The torpedo boats and destroyers are all named for individuals (deceased naval officers) and in many, indeed a majority of instances, for the family name, where several from

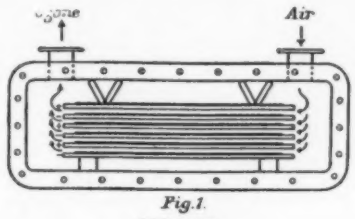


Fig. 1.

OZONISER

the same family have served the United States exceptionally well. (See map.) To tell the history of each of the men for whom these vessels were named would of itself comprise an article, yet no more interesting reading can be found in the archives of any nation than the history of the achievements of these men, who gave their lives in the service of their country. Our readers are advised if they wish to prove that "truth is stranger than fiction" to investigate how Cushing destroyed the "Albemarle;" Morris fought the "Cumberland" against the "Merrimack;" Talbot sailed 1500 miles in an open boat to bring relief to the wrecked crew of the "Saginaw;" Tingey, rather than allow his vessel to be searched, fought and defeated an enemy twice his size; Somers was blown up in an attempt to carry a fireship into the harbor of Tripoli; Decatur burned the "Philadelphia" in the face of the enemy; Whipple captured 23 vessels in one cruise; Worden fought the "Monitor," and the many daredevil feats and glorious victories of Hull, Jones, Bainbridge, Perry, Farragut, Winslow and others are too numerous to mention. A perusal of the history of these men will quickly demonstrate that a battleship is more worthy of their names than the small type of torpedo boat.

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OZONE FOR WATER STERILIZATION.

AT the recent conference on water supplies and river pollution, held at the Sanitary Institute in London, the use of ozonized air for water sterilization was referred to, and it was stated by Dr. Rideal that one of the London water companies was now carrying on experiments on this subject. In view of this fact the following account of the experimental plant erected by Siemens and Halske, at Martinikenfelde, near Berlin, in 1898, and operated since that date, may be of interest to our readers.*

The ozonizers used in this installation are of the Siemens and Halske plate and tube type—shown diagrammatically in Figs. 1 and 2. In the first-named type the high potential silent discharge occurs between parallel plates of metal and tinfoil, separated by somewhat larger sheets of glass. The tinfoil and metal sheets are connected to the positive and negative terminals of the coil respectively, and a series of such couples are inclosed in a box, with inlet and outlet passages for the air. An electromotive force of 12,000 volts is used, and for each pair of plates of 1 square meter discharge surface ½ horse power is required. The yield in this form of ozonizer is 20 to 25 grammes ozone per electrical horse power hour, when the concentration of ozone in the air passing from the apparatus lies between 2½ and 3 grammes per cubic meter.

The tube form of apparatus—shown in Fig. 2—consists of two concentric metal tubes separated by an air space and a cylinder of mica lining the inner side of the larger tube. Water circulates through the inner and around the outer tubes, in order to keep these cool and to prevent decomposition of the ozone already formed. Seven such tubes are connected to form a complete apparatus. This apparatus yields 20 to 25 grammes ozone per electrical horse power hour under the same conditions as regards concentration as before.

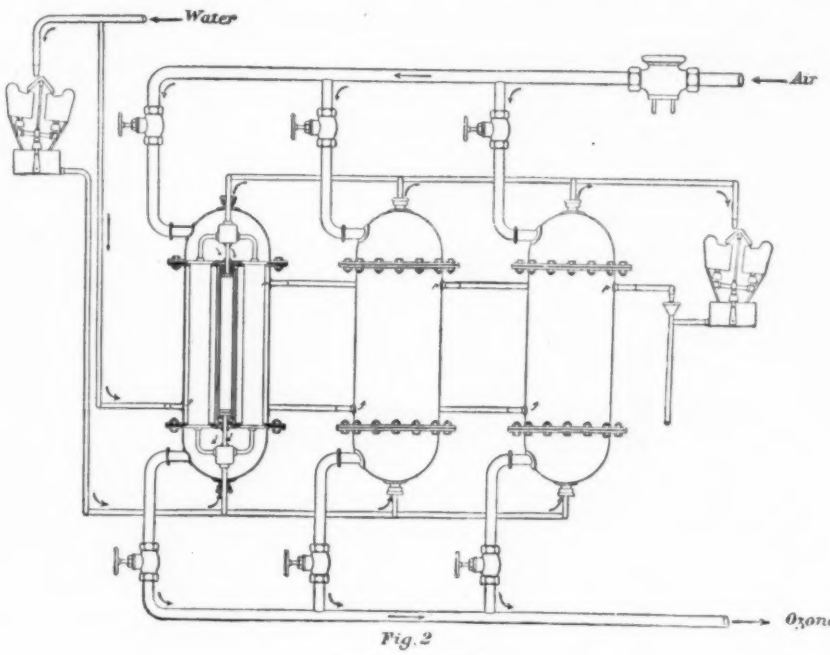


Fig. 2

OZONE MACHINERY

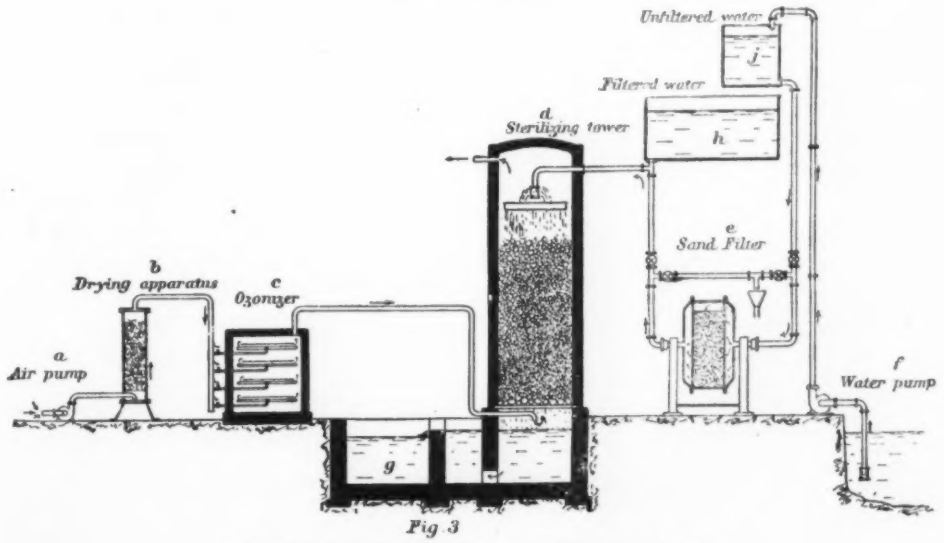


Fig. 3

THE MARTINIKENFELDE WATER STERILISING INSTALLATION

Fig. 3 is a diagrammatic representation of the Martinikenfelde installation, which suffices for the treatment of 10 cubic meters, say 350 cubic feet, water per hour. It consists of an air pump, *a*, which forces the air through the drying apparatus, *b*, into the ozonizer, *c*. This ozonized air then passes into the sterilizing tower, *d*, packed with flints, in which it comes into contact with the descending stream of filtered water. The remainder of the plant consists of the water pump, *f*, a revolving sand filter, *e*, and the tanks, *g*, *h*, and *j*, for the filtered and unfiltered water.

* Based on article by Dr. Erlwem in Zeitschrift f. Elektrochemie, November 14, 1901.

Tests made with this installation using water from the River Spree show that the bacteriological organisms were reduced in numbers from between 100,000 and 600,000 to under 10 per cubic centimeter. As regards chemical results the permanganate absorption figure was reduced by 18 per cent, and the aeration of the water was increased from 10 to 12 per cent. The water, after the ozone treatment, did not show the presence of nitric acid, and no ozone could be detected in it by chemical tests. The consumption of ozone amounted to 2 grammes per cubic meter.

The cost of treatment for an installation yielding 120 to 150 cubic meters per hour worked out to 0.203 pence per cubic meter, made up as follows: Electrical energy, 0.127; wages, repair, etc., 0.0276 pence; interest and depreciation, 0.048 pence, when taking the cost of the electrical horse power hour at 0.587 pence.

The total cost of sterilized water to the consumer, when interest and depreciation charges on the distributing system are included, is estimated to amount to 0.591 pence per cubic meter, or, say, 1s. 4¾d. per 1,000 cubic feet.

The capital outlay upon a sterilizing installation for treating 150 cubic meters per hour is estimated at £6,750, of which total £3,000 represents the expenditure upon buildings, pumps, and sand filter—i. e., the expenditure necessary for the ordinary waterworks—and £3,750 the extra expenditure required by the ozone treatment.—The Engineer.

ELECTRIC RAILWAYS.*

By Major P. CARDEW.

POLYPHASE SYSTEM.

THE polyphase current traction system in operation on several Swiss railways has been very completely worked out by Messrs. Ganz & Co. for a line in Italy now being equipped. Although only recently developed this system appears likely to occupy the field of electric traction, at any rate on long distance lines.

The term polyphase current is applied to alternating currents transmitted through several conductors, the current in each conductor having the same frequency as, and a definite phase relation to, the currents in the other conductors.

This species of electric current does not require a generator differing to any degree in principle from the ordinary continuous current generator, or the ordinary alternating current generator. In fact, identically the same machine can be arranged to produce any variety of current, whether continuous, simple, alternating, two-phase, three-phase, etc.

Our concern at present, however, is rather with the motor than the generator. Now there are two kinds of polyphase motor—one kind is exactly similar to a generator as in the case of continuous currents. A machine of this nature generally has a magnetic field provided by a continuous current, and the machine has the additional drawback that it is not self-starting under load, but requires to be run up to the same speed as it would have to be run as a generator to produce a current of the same frequency as it is receiving. It is hence called a synchronous motor. For these reasons the type of machine is not suitable for traction and we need not further consider it.

The other kind of motor is known as the asynchronous or induction motor. It is self-starting under load and has a torque very nearly equal to that of a continuous current motor under similar conditions. In these machines no continuous current is required and there is no magnetic field fixed in space. They have, it is true, a fixed and a moving portion, but the fixed portion (called the stator) is supplied with the polyphase currents, while the rotating portion (or rotor) receives no current from outside, but on the contrary has currents generated in its own coils by induction. The principle of action is that the polyphase current produces a magnetic field in the stator which rotates at a speed proportional to the frequency of alternation of the current.

The coils of the rotor are generally connected to insulated rings on the axle in order that the currents generated may pass through variable external resistances. Now, when the rotating field of force is acting upon the rotor its coils acquire E. M. F. exactly as if the field of the stator were fixed and the rotor were turning in this field of force with the same velocity but in the contrary direction to the rotation of the field. It is the relative motion between the field and the coils which generates E. M. F. Current is, therefore, caused to flow in the circuit consisting of the rotor coils and the external resistances, energy being thereby wasted by degradation to heat.

Although some energy is wasted in external resistances, still the loss would be greater were no resistances used, and, moreover, the starting torque obtained would be much smaller, although the rotor current would be greater. This rather curious fact arises from the laws of alternating current, and cannot be fully explained without discussing the full theory of the subject. It must suffice to state that the waves of current in stator and rotor would be out of adjustment for production of force.

It would, of course, be necessary to provide the turning force of an engine to rotate the rotor coils in a fixed field of force, and produce the energy running to waste, and the turning force of the engine when the motion was uniform would be opposed by an equal turning force in the opposite direction in the coils.

By means of the rotating field in the stator produced by the polyphase current we have, therefore, obtained an effect in the rotor equivalent to forcibly turning it in the opposite direction by an engine, consequently the force with which it would oppose the turning effort of the engine exists in the rotor, and unless it is opposed by an equal force will cause the rotor to turn in the opposite direction to that of the generation in a fixed field, i. e., in the same direction as the rotating field. Thus we see the cause of the torque in an induction motor.

When the rotor is turning the relative motion between the rotating field and the rotor coils is diminished, because they are turning in the same direction, consequently the current produced by the rotor tends to fall off, but it can be maintained at full strength by reducing the external resistance until the speed of the rotor has attained very nearly synchronism, or a speed equal to that of the rotating field in the stator when the external resistances are entirely cut out, and the rotor coils short-circuited upon themselves.

You must therefore consider the rotor of an induction motor as an electro-magnetic mechanical appliance which receives energy by induction, as it is called, from the stator, wastes part of that energy, like all other machines by converting it into heat, and gives out mechanical power by means of the rest of it. It cannot quite run up to synchronism, even when unloaded, because of friction and other opposing forces; there must always be a slight slip or deficiency in speed. On the other hand, a very slight slip develops a considerable torque; but there is a limit to the increase of torque with increased slip. If the motor be overloaded until the slip exceeds about 15 per cent with a short-circuited rotor, it will stop.

A greater slip, or, in other words, reduced speed, can be obtained by again inserting resistance in the rotor circuit, but at the expense of efficiency. The diagram.* Fig. 1, shows the torque obtained at various speeds expressed in percentages of slip (100 per cent slip being standstill), and with various resistances external to the rotor expressed as multiples of the rotor resistance.

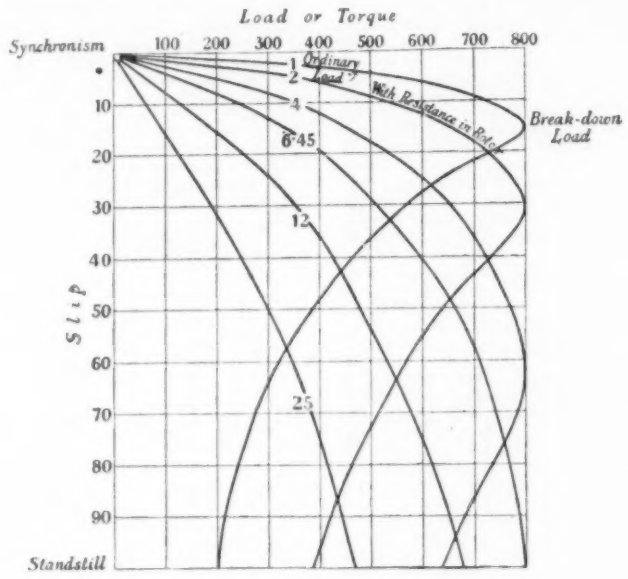


FIG. 1.

Naturally, in practice, care is taken that the greatest possible load that can be applied to the motor is far below breaking-down point. On the Valtellina Railway, in Italy, now being equipped on the three-phase system by Messrs. Ganz & Co., the maximum working torque does not exceed one-third of the breakdown torque. In fact, the breakdown point cannot be reached, for the wheels would skid first.

The diagram of torque supposes that the supply to the stator is maintained at a constant pressure. If this pressure be increased, the breakdown load and the torque at any slip is also increased. In fact the torque varies as the square of the pressure of supply, a very important law.

DIFFERENCES BETWEEN CONTINUOUS AND POLYPHASE MOTORS.

Looking at things from the point of view of practical traction requirements, the chief points of difference between the continuous current and the polyphase motor are:

1. That with the continuous current motor the speed depends upon the electrical pressure of supply and the load. For a steady load the speed increases proportionally to the pressure; for a steady pressure the speed may be reduced considerably by increasing the load. With the polyphase motor, on the other hand, the speed within practical limits is nearly exactly determined by the frequency, or, in other words, by the speed of the generators, and is very slightly reduced by increase of load. The diagrams, Figs. 2 and 3, well exemplify the difference of behavior in respect to variation of speed under varying load of the two classes of motor. The short lines cutting the curves give the maximum rated load.

2. That in the continuous current motor the supply current must traverse the armature, entering by the brushes and the commutator. The pressure of supply must on this account be limited to avoid damage. Even in the case of large continuous current generators a high pressure is a difficulty, and this difficulty is much increased in a motor which has to be fitted into a small space and is exposed to weather. The controlling arrangements would also become impracticable with a high pressure. On the other hand, in the polyphase motor the supply current traverses the stator coils only, and no commutation or variation of this circuit is necessary. A high pressure is, therefore, perfectly practicable.

The question of efficiency must next be considered. We have seen that in the case of the continuous current motor the efficiency, or proportion which the power given out bears to that absorbed, varies from "o" at starting to, say, 90 per cent at full speed. The polyphase motor is much the same in this respect, although the curve of efficiency is rather different, being affected by the lag of the wave of current behind that of pressure which must always be considered when dealing with alternating currents supplying induction motors. We have also seen how the inefficiency of starting is reduced by the series parallel system of control. A somewhat similar system has been worked out for polyphase traction. It depends upon these facts.

CASCADE CONNECTION.

When a polyphase motor is running at synchronous speed no E. M. F. is produced in the rotor because there is no *relative* motion between the coils of wire and the rotating field, but when "slip" exists E. M. F. is produced, the frequency of this E. M. F. being the same proportion of that of the supply as the slip is of the speed of synchronism. Thus if there be a 10 per cent slip the frequency of the rotor E. M. F. and current will be 1-10th that of the supplied power.

Now if the rotor instead of being connected to a variable rheostat is connected to the stator of a second motor before starting, it will generate currents in this stator at a frequency proportional to the slip, i. e., starting at that of the supply and becoming slower as the motors speed up. The second rotor being connected to an external resistance, will generate current at a frequency proportional to its slip.

Now suppose the motors to be mechanically connected so that both motors must move at the same speed, and let this speed be one-half the synchronous speed for the first motor. Under these conditions the slip of the first motor is 50 per cent, the frequency of the current supplied by it to the second motor is one-half that of the supply current, and the slip of the second motor is zero or it is running at synchronous speed. No current will therefore be passing in its rotor even if short-circuited. But what of the current from the rotor of the first motor? This is choked back by counter E. M. F. exactly as with one motor the supply current is choked back when synchronism is attained, thus there will only be a very small current.

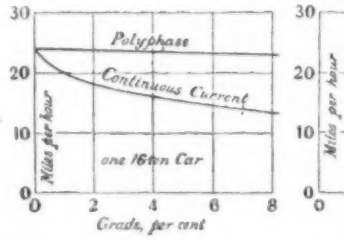


FIG. 2.

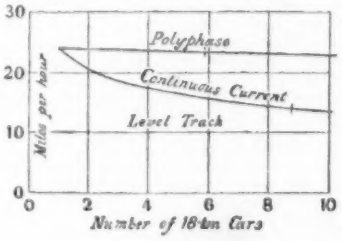


FIG. 3.

In short, it will be evident that with two motors connected as described, half speed is the limit to which they tend, exactly as in the case of two continuous current motors in series. It will be observed, however, that whereas with continuous current motors in series, each motor receives half the energy directly from the supply, with polyphase motors in "cascade," as it is termed, the whole energy is taken by the stator of the first motor, and transmitted inductively to its rotor, which applies one-half mechanically to the axle, and transmits the other half electrically to the second motor.

In order to accelerate from half to full speed, it is not practicable to put the motors in parallel, because the second motor is not wound to take the high pressure of the supply, for it would not be expedient to generate high pressure in the rotor of the first motor.

* Abstract of a lecture delivered before the Society of Arts and published in the Journal of the Society.

* This and several other of the diagrams shown have been reproduced from Prof. Wilson's paper on "Polyphase Electric Traction," by kind permission of the Institution of Mechanical Engineers.

The practice is, therefore, to disconnect the second motor at half speed, substituting a rheostat, and letting the first motor do all the work. The torque obtainable is therefore less for the second period of acceleration. The efficiency is suddenly reduced when the change is made, just as in the change from series to parallel, with continuous current motors, and increases again with the speed.

The diagrams, Fig. 4, show the maximum power, total energy, and time required to attain two different speeds according to Messrs. Ganz & Co., assuming that the automatic rheostat is set to give the best result.

These quantities are connected by the following relationships, neglecting the resistance to motion due to friction and air displacement, and considering merely the acceleration of the mass of the train:

1. The maximum power taken is proportional to the rate of acceleration and the maximum speed required.

2. The total energy required varies as the square of the speed attained and is independent of the acceleration.

These laws are modified by the variation of the resistances to motion. These certainly increase with the speed and a great many formulæ have been suggested to express the connection between speed and resistance. No simple relationship appears to hold through a wide range of velocity. The frictional resistance is distinctly greater at the moment of starting from rest than when the train is running, and is probably less at very high than at moderate speed if the lubrication is efficient; on the other hand, the air resistance increases very rapidly with the speed.

It may be thought that it is not worth while to carry about a secondary set of heavy motors, in order to obtain increased efficiency in starting, or that it might be better to retain the motors, winding and using them as primary motors, and thus obtain increased acceleration, but we have not yet realized the full advantage of the "cascade" connection. We have seen that a polyphase motor tends to synchronous speed, but can never quite reach it so long as it has to provide mechanical power. If, however, as is the case on down grades, when the slope is such that the force of gravity acting in the direction of motion exceeds the retarding forces of friction and air resistance, the motor has not to provide power, but is accelerated above the speed of synchronism, it begins to act as a generator and return electric power to the supply circuit. It takes the power required for generation from the axle, on which it therefore exerts a retarding force or negative torque.

We have seen the analogous action in the case of a shunt or separately excited continuous current motor, and the action is more easily grasped in this case, because the continuous current armature takes current from the supply as a motor and returns current as a generator. But the polyphase rotor does not receive current directly from the supply, being completely insulated from it, nevertheless current flows in its own circuit. This current, however, when it is acting as a motor, is derived by induction from the primary current, and the greater the induced current the greater the primary current; but when acting as a generator, the rotor current actually becomes the primary source of energy, and nearly reverses the phase of the supply current, so that the current from the stator is opposed to the impressed E. M. F. The diagram, Fig. 5, shows the variation of the total current and of the energy producing or restoring current at speeds below and above synchronism, which is at the point, *A*, on the line of speed. Energy is consumed by the motor up to this point, although no external work is done by it beyond the point, *C*, on account of its internal losses. In polyphase traction, therefore, the train is compelled to a practically constant speed up-hill, down-hill, or on the level. It is out of the power of the driver to endanger the lives of the passengers by running at an excessive speed to "make up time."

By the "cascade" connection principle, this braking action, with return of energy to the line, is available not only down steep grades, but whenever a reduction of speed is necessary, whether for stopping at a station or slowing for signals, and from full speed to nearly half speed. The amount of energy returned is about 16 per cent of that used for acceleration on the level, or about 30 per cent of the kinetic energy of the train, and the efficiency of the system is on this account certainly greater than what can be possibly obtained with series wound continuous current motors. If the traffic can be so arranged, the best advantage will be obtained by starting a train on the up line just as an incoming train on the down line begins to slow down, and as the running time on the polyphase system is absolutely fixed, such working is quite possible.

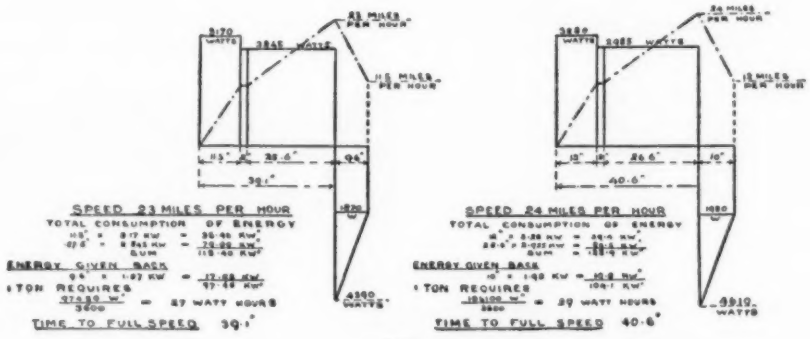

DIAGRAMS OF ENERGY AT STARTING
IN THE CASE OF THREE-PHASE CURRENT
WATT CONSUMPTION PER TON, ON STRAIGHT & HORIZONTAL LINE
CALCULATED WITH AN AVERAGE TRACTION COEFFICIENT OF 10·1 LBS PER TON
SPEED 23 MILES PER HOUR
TOTAL CONSUMPTION OF ENERGY
ENERGY GIVEN BACK
1 TON REQUIRES
TIME TO FULL SPEED 39·1"
SPEED 24 MILES PER HOUR
TOTAL CONSUMPTION OF ENERGY
ENERGY GIVEN BACK
1 TON REQUIRES
TIME TO FULL SPEED 40·6"

FIG. 4.

The braking action at high speeds has other advantages over mechanical braking in that the wheels cannot be skidded and the destructive action on both wheels and rails is much reduced.

COASTING.

In comparing the "cascade" system with the ordinary current system, it must be pointed out that although with the latter no return of energy to the supply is possible, a considerable proportion of the kinetic energy developed by acceleration in the train may be utilized by an experienced driver by "coasting," i. e., by cutting off the power completely shortly after full speed has been attained, and allowing the train to gradually reduce speed through friction and mounting grades.

This practice, however, may obviously lead to considerable variation in the time schedule, and can only be advantageously used by a very careful driver with a thorough knowledge of the road.

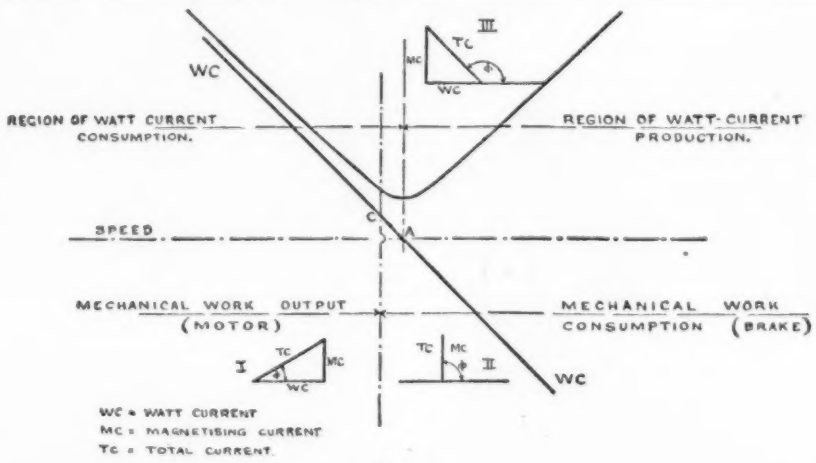


FIG. 5.

REVERSING.

With continuous current reversal of motion is effected by reversing the connections of the armature brushes, but with polyphase motors no alteration of rotor connection will cause reversal since the motion is a consequence of the rotating field of the stator, and it is necessary to reverse the connections of two of the wires bringing in the line currents to the stator, in order to produce a reversal of the direction of rotation of the magnetic field.

FREQUENCY.

The question of frequency is an important one in connection with polyphase traction. We cannot discuss it fully here, but I may state generally that the frequency should be kept low, especially when the "cascade" connection is employed. On the other hand, low frequency increases the weight and expense of motors, and brings in difficulties with regard to electric lighting.

LIGHTING.

The frequency adopted by Messrs. Ganz & Co. is 15 periods, which is far below that at which it is possible to use any separate phase of current for lighting, because the blinking effect caused by the waves of current is painfully perceptible.

In order to prevent this, they propose to use a three-phase lamp, having three filaments all united together at one extremity, while the other ends are connected to separate leading-in wires. In such a lamp, the total light is constant, although the emission from each filament is fluctuating, and if an obscured globe be used, these fluctuations cannot be noticed. It is, however, preferable for train lighting, to ensure a constant steady light by the use of a small accumulator battery, charged during running by means of a motor generator. The same motor which is used for the air compression for the brake can also do this work.

CONTROLLING.

The controlling arrangements for the polyphase "cascade" system have to provide for:

(*a*) The connection of the stator coils of the primary motor to the source of supply, and for reversing these connections for running backward. This is effected by means of a separate plunger switch having six plungers.

(*b*) The connection of the rotor of the primary to the stator of the secondary motor.

(*c*) The connection of the rotor of the secondary motor to a variable rheostat, and the gradual reduction of the external resistance to zero.

(*d*) The cutting out of secondary motor and substitution of the rheostat for it, in circuit with the rotor of primary motor, and the gradual reduction of external resistance as before.

(*e*) The cutting in of secondary motor, with rheostat connected to its rotor, and the gradual reduction of resistance as before.

(*f*) The cutting off of the supply current.

I have not time to enter minutely into the details of these arrangements, but the following are very important items on the system:

(1) The whole control is effected by means of compressed air, so that the driver cannot possibly get a shock by manipulating a switch.

(2) The rate of cutting-out resistances in the rheostat is limited by means of a valve regulating the flow of compressed air; and this valve can be set after determining the best rate, so that the driver cannot waste power by cutting out too fast, or lose time by cutting out too slow.

(3) The rheostat is not, as in other cases, formed of wire resistance, but of iron plates above an alkaline solution, which is forced up by means of compressed air into contact with the plates, reducing the resistance as it mounts higher; and the plates are so shaped that the immersed surface increases rapidly as the liquid rises; the effect being to maintain the starting torque uniform up to full speed.

The above-mentioned controlling arrangements admit of several pairs of motors being worked from one end of the train. In fact, the multiple unit principle has been thoroughly worked out with the compressed air sysem of control.

LINE EQUIPMENT AND CONTACT DEVICES.

Having thus glanced at the principal features of the continuous and polyphase current motors and their controllers, we must next obtain some idea of the line equipment or arrangements for bringing the electrical power within reach of the train, and the contact devices by which it is delivered to the train.

The idea of all electric traction systems using energy transmitted to a distance is to equip the line with one or more continuous insulated conductors, kept charged by the generating station, and with which one or more insulated conductors attached to the train or vehicle make continuous sliding or rolling contact. On tramways we have the ordinary trolley wire, or the conductors in a conduit, or the surface contact studs, which are successively connected to the continuous charged conductor as the car comes over them. On railways the amount of current which has to be collected has required a larger conductor than a trolley wire, and the usual system has been the third rail, as it is called, being an insulated rail, generally of channel iron, supported on insulators, placed either between the running rails, or, especially when two insulated rails have been used, on each side of the running rails.

So far, porcelain insulators have answered best, but the material is, of course, brittle, and a molded insulator of material similar to that used for trolley wire insulators has been recently introduced. The insulated rails are made in lengths of from 30 feet to 60 feet, and each length is bonded to the next.

BONDING.

Bonding is necessary to insure sufficient conductivity at the joints. When a current flows along a metallic conductor the resistance depends upon the cross section and specific conductivity of the metallic conductor, but when the current passes from one conductor to another in contact with it there is a special resistance at the surface of contact depending upon the extent of this surface, the nearness of the opposed surfaces and the force with which they are pressed together. In the case of iron or steel rails copper bonds are generally employed. These consist of a copper conductor often made flexible to provide for the slight relative motion of the ends of the rails caused by the passing weights and by expansion and contraction with change of temperature. The copper conductor spans the gap between the rails, and is furnished with two large terminals which pass through holes in the web of the rail, which are rimered out clean just before the bond is put in. These terminals are then expanded with considerable force so as to drive the metal of the terminal into intimate contact with that of the rail, either by hammering a steel conical pin into a small hole passing through the center of the terminal, or in the case of large bonds as used for railway work, hydraulic pressure is used to expand the terminal as in riveting.

The single rail system, with running rails as return,

has been adopted on the Liverpool Overhead, City and South London, and Central London railways; the double rail system was used on the experimental line on the District Railway. Along these rails slide several insulated iron shoes, attached to the train to collect the current for the motors.

The insulated charged rail, although it appears the most practical device, is not without certain disadvantages. It encumbers the permanent way to some extent, and owing to its proximity to the running rails, short circuits, caused by crowbars or other pieces of metal falling across the two, are not infrequent. The employes are liable to get shocks and burns, which are not generally serious, but may cause injury, and there have been one or two fatal accidents. The insulation also is not perfect, and it is affected considerably by the weather. The possibility of danger is much reduced by the use of two insulated conductors. On the other hand, the inconvenience is increased.

In the case of the South London Railway, I suggested that a strip of wood should be provided at stations to guard the charged rail, so that inquisitive passengers should not be able to touch it with umbrellas, and possibly sustain a shock sufficient to cause them to fall onto the line. These wooden protectors have been used in several instances.

For reasons of safety it would be much preferable to put the insulated conductors overhead, as in the case of tramways, but as the current collected from these conductors by one heavy train may exceed 2,000 amperes, this is impracticable with the continuous current system.

With the polyphase current, however, no such limitation of pressure is necessary, as the stator coils can be safely wound for high pressure. On the other hand, two insulated wires are necessary, as well as the use of the rails to form the third conductor. Messrs. Ganz use 3,000 volts with their system, and the insulated conductors are ordinary trolley wires suspended overhead. Instead of 2,000 amperes at 500 volts continuous current, less than 250 amperes are required at 3,000 volts three phase, and the collection of the current at this pressure is easily effected.

There is, however, one very important consideration, viz., public safety. Five hundred volts may under certain conditions cause serious injury, or even death, but the slight contact which is generally made by an accidental touch does not produce a serious shock. No one, however, can trifle with 3,000 volts.

The Board of Trade regulations prescribe an insulating coating for wires charged to this pressure, which would of course prevent their use for this purpose, but these regulations are concerned with wires erected in the public streets, and carried over houses, past windows, etc., where they may be accessible, or where other wires may get into contact with them. The case is very different on a line of railway to which the public have no right of access, and which is, in any case, a dangerous place for a stroll.

SAFETY DEVICE.

So long as the wires remain suspended, they are well out of reach, and in order to provide against danger from a broken wire, an arrangement has been devised whereby any broken wire must be brought into contact with an earthed conductor before it can fall within reach, the short circuit thus produced causing the cut-out to act, and disconnect the wire from the charged circuit. This device will also act should a wire by stretching, or by the failure of an insulator, droop below its proper position.

On the whole, I consider the danger from properly erected and guarded wires at 3,000 volts along a railway, is no greater than that from a charged rail at 500 volts put between the running rails, or in the 6 foot way.

RETURN CONDUCTOR.

The question of the use of running rails as part of the circuit has been lately very hotly debated. There is no doubt that if this use is not strictly limited it will cause trouble from electrolytic action on pipes and other metallic bodies or structures laid underground, and also that it may interfere with and disturb other electrical circuits using the earth, or the delicate instruments of magnetic observatories.

The Board of Trade regulations prescribe a strict limit to the fall of potential on the rails, which must not be allowed to reach 7 volts. The only practical way to work within these limits with the large currents required on railways with the continuous current system is to tap off the current from the rails at numerous points at short distances apart. In fact the rails must be used rather for the collection than the transmission of current.

This tapping off of current is automatically effected by an arrangement first suggested by myself and now much used on electrical tramways. Each section of line is supplied from the generating or sub-station by means of a pair of feeders, one from the insulated rail or other conductor and the other for the return current from the rails. These feeders are connected at the station to a dynamo called a booster, the line feeder being connected to the magnetizing coil and the return feeder to the armature. The dynamo is kept revolving at a constant speed by means of a motor.

When there is no train upon the section of line and, therefore, no current passing in the line feeder, the dynamo does not generate E.M.F., but when current is passing in the line feeder a magnetic field and, therefore, an E.M.F. is produced proportional to the amount of current. This E.M.F. is in such a direction as to increase the current which would otherwise naturally flow in the return feeder, and it may be so adjusted that all the return current will take this path. It appears curious at first sight, but it is a fact that this limit of fall of potential is almost as troublesome in the case of the 3,000-volt system as when the pressure is only 500 volts in spite of the much smaller current used. The reasons for this are as follows:

In the first place the resistance offered by iron rails to alternating current is much greater than to continuous. It appears to be about two and a half times as great even with the low frequency of 15. Secondly, 7 volts is a much greater proportion of 500 than it is of 3,000, and it is therefore much nearer to the limit which would be worked to were economy of distribution the only consideration.

It is true that the electrolytic effect of alternating current is far less than that of continuous, while as regards disturbance an alternating current of 15 periods is as little disturbing to any instrument or circuit at present in use as any form of current can be, so that it may be possible to allow some extension of the limit laid down in the case of such currents. But the general opinion as regards the Board of Trade regulations has lately rather inclined to the view that it is unduly lenient—a great change from my time—so that I think the alternating current people had better be prepared to work to the limit now laid down if the rails are used as a return. It is very doubtful whether in the case of full scale railways at any rate it will be practicable to make much use of the rails. It will certainly be uneconomical to do so if a satisfactory means of providing a completely insulated circuit can be devised.

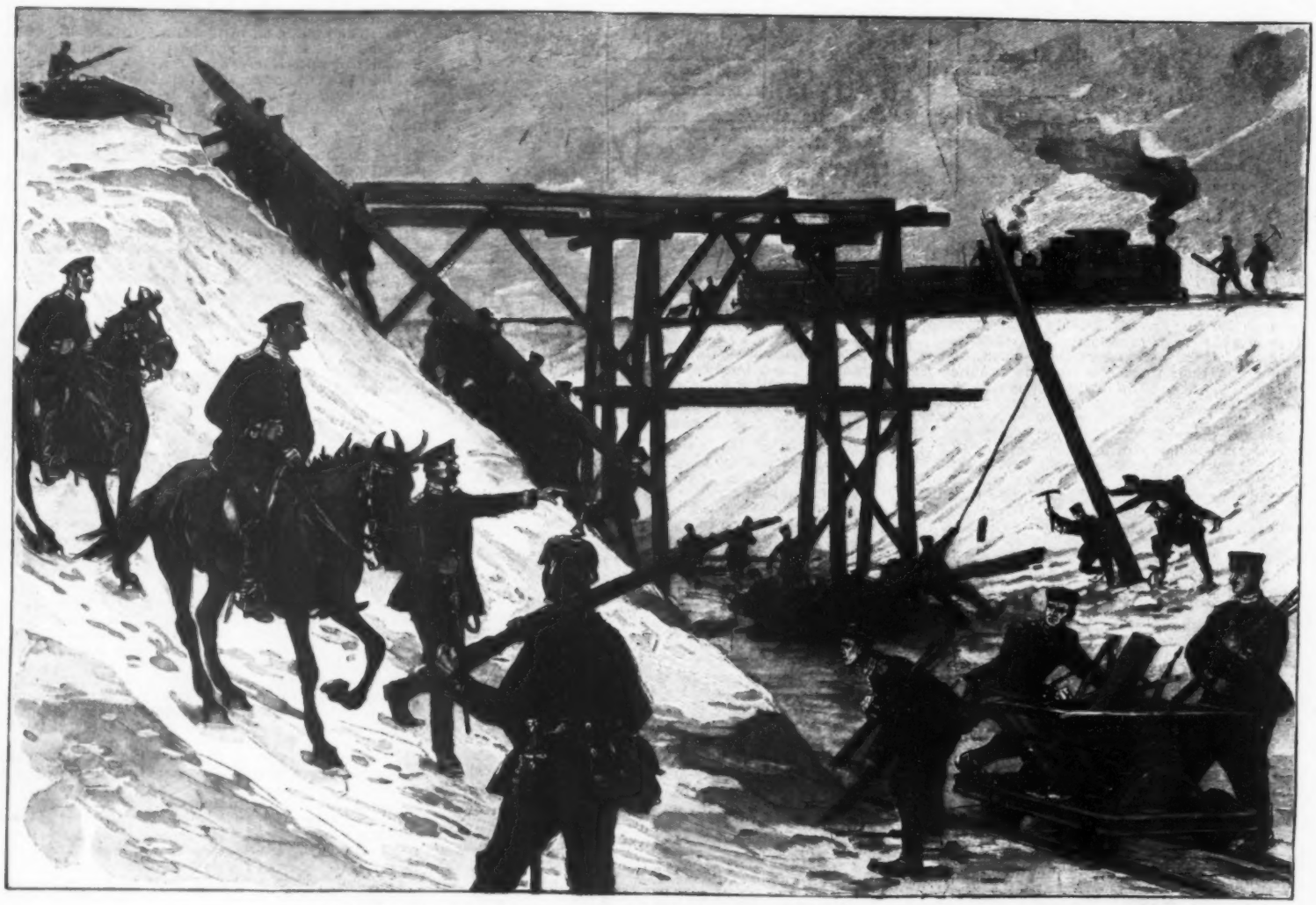
With continuous current and low pressure, the use of two insulated rails for each line laid in the permanent way is a considerable objection, but the chief difficulty to be overcome is in providing for points and crossings where both insulated rails have to be discontinued.

With polyphase current and two overhead wires, one wire alone has to be discontinued, and the train can get one phase of current so long as the rails are used as a conductor. In this case, however, it seems quite practicable to provide for the return a fairly-insulated copper conductor in the permanent way to be rubbed by shoes attached to the train, and the breaks in this conductor at crossings need only be short ones. This conductor would be connected to earth at each transforming station, so that very moderate insulation would suffice, and no shock from it need be apprehended.

GANZ'S TROLLEY POLE.

The contact device proposed by Messrs. Ganz is a kind of double trolley pole, carrying elongated rollers, one for each wire. The wires therefore need not exactly follow a curve, but can take it by successive angular changes of direction, and shift along the rollers. The trolley poles are mounted on the roof of the motor coaches, and are hinged to lie flat on the roof, but are elevated to the required angle by means of springs. These springs are extended by a piston actuated by compressed air, so that at any time contact with the high pressure wires can be broken by releasing this air-pressure, and can be re-made without exposing the driver to the slightest risk of getting a shock.

It is further provided that the key to give access to the high pressure apparatus is only available for use when the valve controlling this piston is open, so that there is no possibility of any connection with charged wires.



WINTER MANEUVERS OF THE RAILROAD BRIGADE NEAR BERLIN.

GERMAN RAILROAD TROOPS BUILDING A BRIDGE.

THE immense importance of railroads in present warfare has led most governments during the last decade to maintain even in times of peace special technical troops whose peculiar schooling capacitates them for building, destroying and running railways as well as the accessory equipments. Thus a railroad battalion was formed in Prussia in May, 1871, and at the mobilization in 1866 and 1870 three railroad divisions or

five field-railway divisions were called to life, to which, later on, a Bavarian division was added.

As a model for all these organizations served the experiences in the North American secessional war, in which the railroads were largely and incessantly employed for a variety of military purposes, the Northern States finally having at their disposal a well-organized military railroad corps of 25,000 men.

The Prussian railroad troops were in 1875 increased to a regiment, and then to a brigade, and consist to-day of a brigade composed of three regiments of two battalions each, which in turn consist of four companies, as well as an equipment division, in which are incorporated two Royal Saxon companies and one Saxon detachment. Besides, Bavaria has one railroad battalion. In all, the German railroad troops number in peace 185 officers, 723 corporals, 3,778 privates, 15 army surgeons, 9 paymasters and 8 gunmakers, this body being reinforced at the outbreak of a war by calling in officers and men of the disbanded class.

The Prussian railroad brigade has at its disposal for the purpose of technical instruction of the railroad troops, the military railway between Berlin and Jueterbog, 70.5 kilometers in length, a road which serves for the connection of the artillery practice ground near Cummersdorf or Jueterbog with the capital of the empire, as well as for public traffic.

Our illustration shows railroad troops in the country at Suedende not far from Berlin in the "Rauhe Berge," engaged in a maneuver, such as is also conducted in winter. The object is the construction of a railroad bridge over a ravine. The necessary material has been brought on by a field railroad branching from the military railway. On nightfall, the country is illuminated by acetylene gas. When the bridge is finished, loaded trains are run over it to test its utility. The dinner of the men is sent from the barracks in large receptacles, while the troops boil their coffee on the spot over the bivouac fire.

For our illustrations and the accompanying description we are indebted to Illustrirte Zeitung.

THE MECHANICAL HANDLING OF BAGGAGE.

THE handling of baggage at the new Orleans station of the Quai d'Orsay is now done mechanically, with a rapidity and ease, and, it may be said, elegance, which the public has never been accustomed to witness.

The station is divided into two stories—a ground floor upon which are installed the services connected with the arrival and departure of passengers, and a basement reserved for the loading and unloading platforms and tracks. The planes of these stories are separated by a distance of 19.6 feet, but, since the rails are 2.75 feet below the platforms, there is a space of but 17 feet between the floor of the upper story and that of the basement.

It will be seen that, being given this general arrangement of the station, it became necessary, for the handling of the baggage, to organize a new system, since it was impossible to think of doing the work by hand.

For shipment, it was relatively easy to find a means of handling trunks, etc., since the latter have only to be let down from the ground floor to the basement, and, for the performance of this operation it was possible to employ gravity as a cheap and easy method.

The passenger, upon leaving the car that has brought him to the station, has his baggage placed upon a light truck, which immediately takes it to a weighing machine, where it is weighed and labeled. The owner receives a provisional luggage bill containing all items except the charges, and which is to be exchanged for a definitive bill at another wicket. The object of this two-fold operation is to expedite the work of registering, and to render it possible rapidly to clear the approaches to the halls by sending the luggage to the basement. To this effect there have been installed elevators and chutes which communicate with the platforms from which the trains start. These apparatus are always juxtaposed, so that, in case of accident, one may take the place of the other. The electric elevators, constructed by the Edoux establishment, are capable of raising or lowering 1,100 pounds of baggage at a speed of 3.28 feet a second, and 2,200 pounds at a speed of 1.65 feet. The 500-volt current used for the lighting service is employed for the main power; while, for the secondary power, a current of but 125 volts is used.

The chutes are formed of riveted plates of iron presenting, in section, a floor 2.6 feet in width provided with two lateral walls 12 inches in height. As for the slope, that has been calculated somewhat empirically in taking into account the space available and the data furnished by the great department stores, which, for some time past, have been employing chutes for the descent of bundles and the loading thereof in wagons. The slope is about 5 inches to the foot; but it has been sensibly increased at the curves because of the resistance that the packages might have to undergo at such places because of friction against the walls. At the lower part of each chute the profile presents the form of a curve designed to diminish the velocity of the object's fall. Moreover, a sort of buffer fixed at the lower end prevents shocks and consequent damage (Fig. 4).

Each of these chutes consists of two parts—one stationary, and the other movable and capable of being raised by means of chains to a height of 6.5 feet above the floor in order to leave traffic unobstructed upon the sidewalks of the platform.

Before speaking of the handling of baggage at its arrival, let us say a few words concerning the delivery office, which is installed at a height of 25.5 feet above the ground floor. An elevator is arranged for raising the goods. The traveler who desires to get his luggage presents his ticket to an employé, who places it in a small apparatus through which it is transmitted to an agent in the upper story who receives it and, after finding the articles called for, puts them into a circular helicoidal chute through which they slide to the ground floor. The advantage of this chute is that it permits of the descent of packages without taking up much space.

When it is a question of raising baggage from the basement to the ground floor, the handling becomes more difficult. The operation, in fact, must be performed very rapidly, since as the trains do not stop very long upon the tracks of the station, it is necessary that they shall be quickly discharged in order to leave the place free for the arrival of other loads. Moreover, there has been established a system of distribution that permits travelers to find their trunks instantaneously, and that thus prevents the obstructions that are liable to occur at certain hours of heavy traffic, when trains come in in succession one behind another.

The trains stop at two platforms placed along the same sidewalk. The passengers, upon leaving their compartments, find at the end of the platform a stairway that takes them to the ground floor, at the side of the great entrance court. If they have no baggage, they leave the station at once. Otherwise, they walk back to a large hall, open to everybody, in which are placed the distributing tables. There are two very distinct operations in the handling of the baggage: (1) the raising of the articles to the ground floor; and (2) the distribution of the same upon the different tables, so as to allow of a sorting that shall permit of their identification and speedy removal.

FIG. 1.—ENDLESS BELT OR CARRIER AND ELEVATOR FOR RAISING BAGGAGE TO THE GROUND FLOOR.

FIG. 2.—ARRANGEMENT OF THE MOVABLE AND SORTING TABLES FOR THE DISTRIBUTION OF BAGGAGE.

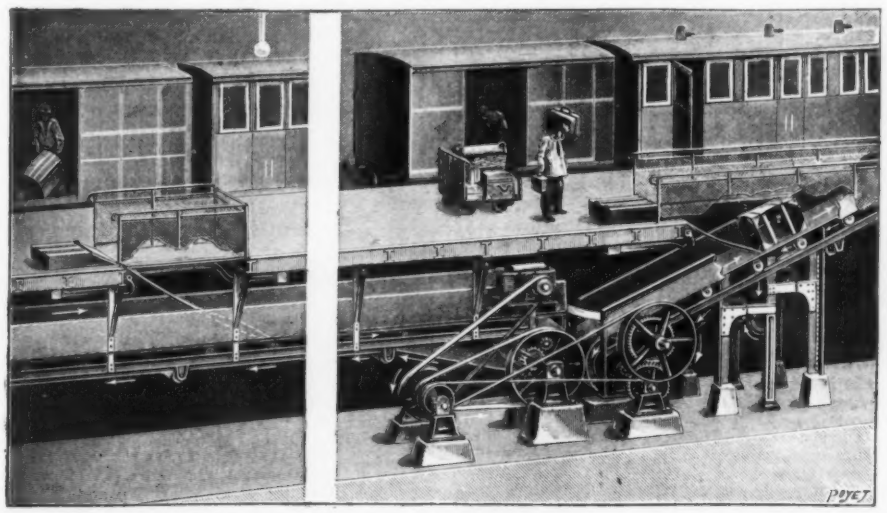


FIG. 3.—HANDLING OF BAGGAGE UPON ITS ARRIVAL. PLACING LUGGAGE UPON THE ENDLESS BELT.

For raising baggage to the ground floor, two apparatus are employed—elevators and endless belts (Fig. 2). The first are actuated by electricity, and are in all respects like those employed for outgoing baggage. The endless belts constitute an innovation in the railway industry that merits more than passing notice.

The trains arriving at the station are, as a general thing, provided with baggage cars in front and rear. It was therefore necessary to devise some arrangement that should permit of removing the baggage from these two points of the trains and transfer it to that part of the ground floor where the sorting is done.

The men whose business it is to unload the forward baggage car have in front of them an endless belt or carrier upon which they place the baggage. This belt first runs upward so as to carry the luggage to a height of 6.5 feet above the ground floor, then horizontally, and finally downward (Fig. 1). The object of this latter motion is to cause the baggage to slide onto the table where the sorting is done.

The rear baggage cars are unloaded in the same manner; but, since it is never known what place they are to occupy in the making up of the train, and since it is important that the baggage shall be placed at once upon the endless belt without any manual labor, there is arranged in a trench under the platform a horizontal supplementary belt which carries the baggage to the ascending one (Fig. 3). For performing this operation, four hoppers are arranged upon the platform into which the baggage is thrown, and as it falls upon the belt in motion, it is carried to the ascending belt. These hoppers are balanced and movable around a horizontal axis so that they may rise for the passage of the trunks placed in the preceding hoppers.

The ascending part of the chute carries the baggage up to the sorting table, to the same point as that toward which are directed the trunks brought by the belt ascending from the forward baggage car (Fig. 2). The employés standing in front of this table therefore find before them all the contents of the baggage cars, even though the latter formed part of two trains arriving at the same time.

It is now a question of sorting the baggage. Two movable tables are installed to the right and left at right angles with the endless belts. These tables are always in motion, owing to a special device arranged like an endless chain. The employés who do the sorting place upon the table to the right all the trunks of which the figure of the label ends in 1, 2, 3, 4, and 5, and upon that to the left those of which the end figure of the labels corresponds to 6, 7, 8, 9, and 0.

At right angles with each of these movable tables there are five stationary ones, opposite which stand employés whose business it is to watch all the trunks that pass in front of them. Now, since each of these tables corresponds to one of the figures terminating the number of the label, all that each employé has to do is to seize the trunk in its motion and place it upon the table which he has in charge. In this way, the traveler who wishes to find his baggage has merely to approach the table marked with the sign corresponding to the last number of the figure of his bill. It will be seen that this series of maneuvers must greatly facilitate the operations of identification and thereby reduce the time taken to remove the baggage upon its arrival.

In addition to the endless belts, there are, as we have said, elevators for raising objects which, by reason of their form, cannot be placed upon the belts, such as bicycles, etc.

This very rational and practical method of handling baggage presents a host of advantages, but also has its drawbacks; in the first place, it is attended with a great expense for the use of the electric current necessary for actuating the apparatus, and, in the second, it requires a large force of men, who find employment only during the time of the delivery of the baggage. Such a process is adapted only for a very large station having at its disposal a large force to draw upon at certain moments.

For the above particulars and the engravings, we are indebted to La Nature.

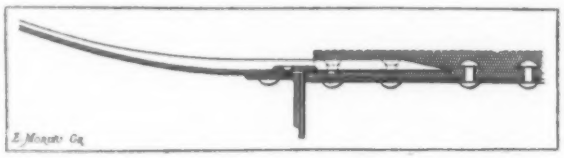


Fig. 4.—JUNCTION OF CHUTE AND BUFFER.

TREASURES OF THE INDIES.

The curious revelations of M. Arnould Boscowitz, so well known for his works on the precious metals, on the extraction of gold and silver, and on diamond mines, relative to the accumulation of treasures in India reads like a chapter of the Thousand and One Nights. These fabulous treasures are concealed in secret places of all kinds, as in the wonderful cave penetrated by Ali-Baba, to whose astonished eyes were revealed the glittering gold and precious stones.

The total value of the gold produced in the two worlds since the discovery of America may be estimated at about fifty billion francs, and this flood of gold which has been poured upon the earth for the last four centuries has been sunk again in part in the Indies. It has re-entered the earth and is more firmly held than in the primeval veins. The value of the gold imported into India during a period of about sixty years, from 1837 to 1898, exceeded by nearly four billions that of the gold exported. The soil of India absorbs floods of gold, as great streams are drunk in by the desert sands.

When it is considered that this absorption has gone on unceasingly for a dozen centuries, and still continues, some idea can be formed of the colossal amount of the treasures.

The gold does not enter into monetary circulation; it is not utilized in native goldsmith work. It is lost to industry and to the world.

An imaginative romancer, laying the scenes of one of his narratives in a mining country, said that if some legendary giant should, with a blow of his prodigious saber, cleave our globe, he would see with astonishment that the interior is crowded with men. If this saber could thus open the soil of India, vast accumulations of wealth in subterranean caverns would be revealed. Aladdin, descending with his lamp, would not be able to count the gold pieces collected during all the centuries of coinage, before those that bear the stamp of modern effigies.

What was the origin of this acquisition of treasures? In ancient times, individual property had no protection in India. Rival tribes contended for immense territories, and the conquerors ravaged without mercy, holding as booty all the riches of the vanquished. The people were led to conceal their valuables, and their enemies were not the only ones to be dreaded; their monarchs, the powerful "rajahs," never lost an occasion of despoiling them under diverse pretexts. To escape from all this spoliation, the hiding places were never too numerous.

The inveterate custom of such concealment has become hereditary among the inhabitants of India. It increased still further on the conquest by the English, for these foes appropriated all the treasures they could discover. The people more than ever resorted to the method of their ancestors, and the streams of gold vanished from sight.

It is of course impossible to give more than a guess at the billions of gold stored in secret places. For over a generation, for instance, the piasters of Mexico, a country where the issue of gold pieces is not limited, have poured into India. They do not return, and the tide still sweeps on. Not only gold, but precious stones have been thus engulfed.

The rajahs, dispossessed by England, have increased their fortunes by all means in their power. They have been insatiable treasure collectors. Like the avaricious Harpagon, their beloved "strong box" has for them beautiful eyes, more beautiful than those of the houris dreamed of by the poets.

The tour of the Maharajah of Kapurthala in Europe has been the subject of much comment. Some idea of his wealth may be gleaned from the statement that the jewels worn by him when in full dress are worth nearly four millions of francs. He is one of the least avaricious. He knows how to spend money. Riches in superabundant profusion are displayed in his palace. The interior decorations are superb; above all, the ceilings and walls, with their splendid moldings and bright colors, embossed with gold and silver decoration, are marvels of oriental art. The palace of the Maharajah at Kapurthala is a wonderful piece of architecture, of which the columns are perhaps the only example of their kind in the world.

Besides the dwellings that he owns in his own states, the Maharajah has others at various points; some in his possessions in Oudh, and some in the mountains of Himalaya. It is thither he resorts with all his suite, as soon as the heat becomes oppressive, and this princely removal costs not less than half a million francs.

The history of another rajah is instructive. After he had been deposed from power, the monarch of Sindhi, submitting to England, received a very large annuity. He appeared quite satisfied, contenting himself with demanding persistently in addition, the restitution of the fortress of Guailor. This fortress was situated in an almost isolated country, in a strategic position of no importance. The government made a formal objection and then yielded this citadel to the rajah. After a long time the secret of his persistence leaked out. He had concealed in the citadel 1,000,000,000 francs in gold coin, which had been buried carefully in the rock forming the foundation of the fortress. The entrance of the subterranean hiding place had been walled up with an art so perfect that it was impossible to discover the opening.

Not alone in the citadels and palaces of the rajahs is gold stored away. The temples are hiding places, and many idols are of massive gold. This country of the fairies preserves the prestige of legendary story. It is still the land of mysteries, of hidden retreats, of inaccessible caverns. If the magic wand should strike its soil, gold would pour forth, as to the *open sesame* of Ali-Baba.—Translated from Le Diamant.

TRADE WITH THE TROPICS.

The prominence given to the commerce between the United States and the Philippine Islands through the recent decision of the Supreme Court and the necessity for legislation on that subject lends especial interest to some figures prepared by the Treasury Bureau of Statistics relative to the present imports from the Philippines and the constant demands of the United States upon the Tropics for articles of daily requirement. These figures show that the total value of imports from the Philippines in the ten months ending with October, 1901, were $3,186,953. Of that sum only $222,797 was dutiable and $2,964,156 was free of duty. Of the dutiable imports, $188,159 represented the value of sugar, the value of all other dutiable articles being $34,638. Of the free importations, $2,945,771 was Manila hemp, and all other free articles $18,385. The importation of hemp from the Philippines in 1901 shows a large reduction, compared with the corresponding months of 1900, due in part to the small production of hemp in the islands during the crop year of 1900, and in part to a great reduction in price. In the ten months of 1900 ending with October, 27,966 tons of Manila hemp imported was valued at $5,225,261, and in the same months of 1901, 20,579 tons of hemp imported from the islands was valued at but $2,945,771, the decrease in price thus being from $187 in 1900 to $143 per ton in 1901 for the period under consideration.

The very small proportion of our sugar consumption which the Philippine Islands are supplying is shown by a comparison of the above figures of sugar imported from the Philippines with those of our total sugar importations during the year. The total importation of sugar into the United States in the ten months ending with October amounts to about 4,000,000,000 pounds, valued at about $100,000,000; and of this enormous total, only 11,424,000 pounds, valued at $188,159, came from the Philippine Islands. In other words, they have supplied during the present year about one-fifth of one per cent of the total value of our importations of sugar. The October report of the Bureau of Statistics shows that our importation of sugar from all countries except Hawaii and Porto Rico amounted to 3,346,065,267 pounds, valued at $72,985,081. The reports from the Collector at Hawaii show that there was shipped to the United States from those islands in the ten months ending with October, 1901, 645,095,290 pounds of sugar, valued at $24,454,076. Add to this the amount shipped from Porto Rico, and our total importations of sugar during the ten months will aggregate the figures above named—four billion pounds, valued at $100,000,000.

These figures of the sugar importations indicate in some degree the dependence of the United States upon the Tropics for the requirements of daily life. Of the $100,000,000 worth of sugar imported into the United States in the ten months of 1901, all but about $12,000,000 worth came from the Tropics. During the same time the importations of coffee amounted to $57,994,303; raw silk, $23,996,615; rubber, $23,363,768; hemp, sisal, jute, etc., $21,190,923; tobacco, $13,802,700; tea, $6,780,379; cotton, $6,000,238, and cacao, $5,579,031.

The following table shows the value of the importations of tropical and subtropical productions into the United States in the fiscal year 1901, including in the statement all sugar, of which, as already shown, the very large proportion is from the Tropics:

TROPICAL AND SUBTROPICAL IMPORTS INTO THE UNITED STATES DURING THE FISCAL YEAR 1901.

Articles.	Value.
Sugar	$90,487,800
Coffee	62,861,399
Silk, raw	30,051,365
India rubber	28,455,383
Vegetable fibers	22,932,506
Tobacco and manufactures	19,770,526
Fruits, etc	19,586,703
Tea	11,017,876
Cotton, raw	6,787,828
Cocoa	6,761,669
Gums	6,639,139
Spices	3,563,109
Cabinet woods	2,993,349
Rice and rice flour	2,324,898
Cork and manufactures	2,270,995
Licorice root	1,737,097
Indigo	1,402,894
Dyewoods	1,274,445
Cinchona barks	1,025,546
Vanilla beans	875,229
Sponges	717,550
Chocolate	141,892
Gutta percha	130,957
Total	$323,810,155

IMPORTS OF JAPAN.

The recent high price of American cotton caused the United States to take third rank in 1901 in the list of countries from which Japan drew her imports, and transposed India to the second place, leaving the United Kingdom still at the head of countries from which Japan draws her importations. The December, 1901, statement of the commerce of Japan, which has just reached the Treasury Bureau of Statistics, shows that the imports of raw cotton into Japan from the United States, which amounted to 1,112,834 piculs in 1900 (picul = 133.3 pounds) fell to 458,432 piculs in 1901; while the imports of raw cotton from India increased from 766,847 piculs in 1900 to 1,667,425 piculs in 1901. The value of the imports of raw cotton from the United States fell from 27,010,134 yen (yen = 49.8 cents) in 1900 to 12,986,748 yen in 1901; while that from India increased from 17,863,925 yen in 1900 to 38,118,831 yen in 1901. The average price per picul of American cotton imported in 1900 was 24.27 yen, and in 1901 28.33 yen; while the price per picul of the cotton from India was 23.29 yen in 1900 and 22.86 yen in 1901. It will be observed that American cotton increased 16.7 per cent in cost per picul in 1901 compared with 1900, while Indian cotton fell in price about 2 per cent, and that the average price of American cotton was in 1901 23.9 per cent higher than that of Indian cotton. With an increase of 16.7 per cent in the price of American cotton and a decrease in the price of Indian cotton, thus bringing the cost of American cotton nearly 24 per cent higher than that from India, the result was inevitable—a marked reduction in the imports of American cotton and a marked increase in the imports of Indian cotton.

Notwithstanding, however, the temporary check in imports of this single article by Japan from the United States, the general imports of that country in 1901 give to the United States a very satisfactory standing, and show that aside from the abnormal conditions by which this single article—cotton—is affected, Japan continues to increase her demands upon the United States. They also show that the growth in imports from the United States during the period 1890-1901 has been much larger than from any other country in the world. Taking the total imports into Japan, including both manufactures and raw materials, the imports from the United States have grown from 6,874,531 yen in 1890 to 42,769,725 yen in 1901; those from Germany from 6,856,955 yen in 1890 to 28,320,097 yen; those from the United Kingdom, from 26,619,102 to 50,575,781 yen; those from India, from 8,910,891 yen in 1890 to 42,779,900 yen in 1901; those from China, from 8,849,685 yen in 1890 to 27,256,979 in 1901. Thus while the United States is temporarily transposed to third place in the list of countries from which Japan

draws her imports, by reason of the abnormal conditions in the prices of cotton, the record of growth is more favorable to the United States than that of any other country, the imports of the United States into Japan being in 1901 more than six times as great as in 1890; those from India less than five times as great, those from Germany four times as great, those from China three times as great, and those from the United Kingdom about twice as great.

The following table shows the total imports into Japan from the United States, United Kingdom, Germany, China and all other countries in 1890 and 1901, respectively:

	1890. Yen.	1901. Yen.
United States	6,874,531	42,769,425
United Kingdom	26,619,102	50,575,781
Germany	6,856,955	28,320,097
China	8,849,685	27,256,979
India	8,910,891	42,779,900
All other countries.....	22,443,710	64,114,462

EVOLUTION OF HEAT ON WETTING POWDERS.

By M. BELLATI.*

THE author discusses the two theories put forward to explain the development of heat when a powder is moistened with water. According to the first, an enormous compression occurs in the stratum of liquid in contact with the surface of the solid, this being supported by the experiments of Bunsen showing that a very thin film of water remains on the surface of glass even at very high temperatures, and that carbon dioxide is extremely soluble in such a film. On moistening sand with water, Jungk found that below 4 deg. an absorption of heat occurred, while Meissner obtained heat development even at 0 deg. The author describes experiments made on the moistening of fine river sand with water, the changes of temperature being measured by means of a thermo-electric pile connected with a galvanometer. The cooling observed by Jungk is not noticed, and when the sand employed was previously dried by gentle heating, the change of temperature is in all cases several tenths of a degree. Heating is also obtained, although to a less extent, when sand containing iess than 1.4 or more than 2.1 per cent of water is moistened with its own weight of water; when the content of water lies between 1.4 and 2.1, the results are inconclusive, in some cases cooling and in others heating taking place. Any cooling which does take place at temperatures below 4 deg. with suitably moist powders is very slight, and the observations of Jungk must be regarded as inaccurate.

The second hypothesis, originated by Cantoni and expanded by Martini, supposes that the moistening of such powders (which are described as "hygrophile" owing to the fact that they absorb a certain amount of water without losing their pulverulent character) is in some respects analogous with the phenomenon of solution, the evolution of heat observed being due to the solidification of part of the water absorbed by the powder. Martini's measurements of the specific heat of such absorbed water gave a value of about 0.5; that is, the same as for ice and for the water of hydrated salts. On repeating these determinations by a more delicate and direct method, the author obtains for the specific heat of the absorbed water values differing but slightly from unity.

It is probable that the heat evolved when a powder is moistened with a liquid is the net result of the replacement of the free surface of the solid by a solid-liquid surface of contact and the addition of a liquid-air surface.—Science Abstracts.

PROCESS FOR THE MANUFACTURE OF COMPLEX ORGANIC COMPOUNDS OF CHROMIUM OXIDE.

THIS process is characterized by the fact that chromic acid or salts of chromium and acids are made to react on glycerine, sugar, molasses, dextrine, starch, etc., in such a manner that a partial oxidation of these bodies is produced and that there is brought into complete solution the product of reaction obtained by the addition of a small quantity of an organic or inorganic acid (an acid which, if it is not oxidized by chromic acid, may at the commencement of the reaction be added to the other constituents of the preparation).

Example I.—830 grammes of glycerine (26 deg.) are mixed with a liter of water. Then the following solution is allowed to fall into the mixture drop by drop:

244 grammes pure chromic acid.
50 grammes commercial sulphuric acid (66 deg.)
1,100 grammes water.

The above operation is continued from three to four hours in such a manner that the temperature of the mixture does not exceed 30 deg. C. It is allowed to stand for three or four days, during which time the whole is converted into compounds of chromium oxide. About 3,500 kilogrammes of a solution, distinctly green, of 25 deg. Be. are obtained.

Example II.—The two following solutions are prepared:

1,830 grammes of glycerine (26 deg.)
900 grammes of water.
2,380 grammes of potassium bichromate.
1 liter of water.

The two solutions are mingled and a mixture added of:

190 grammes of sulphuric acid (66 deg.)
200 grammes of water.

This introduction should be made slowly and be kept up with agitation for about five hours. Five days later, the preparation presents the same peculiarities as the product of Example I.

The green products finally obtained are soluble with difficulty in water, but easily in an alkaline solution; and are likewise soluble in diluted mineral acids and in strong organic acids. To dissolve the product of the reaction it is sufficient to take a quantity of sulphuric acid equal to one-eighth of the weight which would be necessary to convert the chromium oxide into chromium sulphate.

The green solution obtained, as described, does not change its color even after several months of rest, and the alkalies have likewise no perceptible influence on it.—From the French of M. Eberle, in La Revue des Produits Chimiques.

* N. Cimento, 12, pp 291-300, Nov.-Dec., 1900. From the Atti del R. Istituto Veneto, T. 59, pp. 931-947, 1900.

THE VENTILATION OF DARK-ROOMS.

By Prof. W. F. WATSON.

IT is a well-known fact that the continuous breathing of air in a room which is not properly ventilated is very harmful, while the attempt to live in an air-tight room with no ventilation would soon result in death. Yet it is surprising that many photographers, who are up-to-date in other respects, have failed to provide for proper dark-room ventilation. Their dark-rooms are like the Black Hole of Calcutta in more than one particular.

In ordinary rooms, where the doors and windows are not very close-fitting, the pure air is constantly

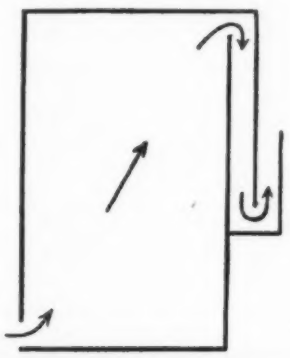


FIG. 2.—ARROWS INDICATE DIRECTION OF AIR CURRENT.

entering through every crack and cranny, and a current of air is passing up the chimney through the stove or fireplace. But the dark-room is generally an inside room, removed from doors and windows as far as possible. In its construction great care is taken to keep out white light by closing every opening and crevice. But fresh air is also kept out, and when the operator enters and closes the door, he breathes the same volume of air over and over again. The results of re-breathing vitiated air are too well known to need description. Headache, lack of energy, general ill-health and even consumption may result from the slow poisoning of the body in badly-ventilated dark-rooms.

A very convenient and satisfactory method of dark-room ventilation (and illumination) is shown in the accompanying illustrations. In Fig. 1 a small door is left open, showing a gas jet placed in front of the ruby glass window, which permits the necessary red light to enter the dark-room. But this flame is also utilized for

FIG. 1.—PHOTOGRAPHIC DARK-ROOM VENTILATION.

ventilation. When the small door is closed, the flame creates a draft and the heated air rises. A continuous current of air then flows from the dark-room to the flame, following the course indicated by the arrows in the diagram, Fig. 2. At the back of the dark-room, near the floor, an opening is made which allows the air to enter by way of a tortuous passage through which the light will not pass. The air takes the course indicated by the arrows, rising to the top of the room, flowing down the passage and then upward by the flame. In this way a steady stream of fresh air is supplied to the dark-room, and the most thoughtless photographer will never fail to set the air current in motion, as he is compelled to light the gas in order to have light to work by. When gas is not convenient, a kerosene lamp placed in the proper position will, of course, give the same results as the gas flame.

GAZETTEER OF CUBA.

"A GAZETTEER of Cuba" by Henry Gannett, Geographer, is the title of Bulletin No. 192 of the United States Geological Survey, now in press, but not yet published.

Cuba, the largest and most populous of the West Indian islands, lying directly south of Florida, has an extreme length, from Cape Maisi on the east to Cape San Antonio on the west, of 730 miles, a breadth ranging from 100 in the east to 25 miles in the neighborhood of Havana, and an area, including the Isle of Pines and the bordering keys, of approximately 43,000 square miles.

The north coast is mainly steep and rocky. In the western part of Cuba the bluffs are low; toward the eastern end, in Santiago Province, the coast is rugged and almost mountainous. The south coast from Cape Maisi westward to Cape Cruz is bordered by mountains, partly by the Sierra Maestra. West of Cape Cruz is the Bay of Buena Esperanza, into which flows the Rio Cauto, the largest stream of the island. Thence westward the coast is low and marshy, broadening, west of Cienfuegos into the Great Zapata Swamp, 75 miles long and 30 miles broad. Off the southern coast are mainly low, mangrove-covered islands. Most of the harbors of both coasts have narrow crooked entrances opening into sheltered basins. The middle portion of the island, including the provinces of Havana, Matanzas, Santa Clara, and Puerto Principe, consists of broad, undulating plains and shallow valleys. Throughout Pinar del Rio Province in the west, parallel to the coasts, runs a watershed, the Organ Mountains, exceeding 2,000 feet, whose southward slopes form the celebrated Vuelta Abajo tobacco land. In Santiago Province the Sierra Maestra reaches altitudes exceeding 5,000 feet, and one peak, Turquino, is 8,320 feet high. The rivers of Cuba are numerous, but short, and few are navigable except through their estuaries. The Cauto, in Santiago Province, is navigable for about 50 miles, and the Sagua Grande, in Santa Clara Province, for about 20 miles. The interior of the island is dependent on only 1,100 miles of railroad and its poor wagon roads for intercommunication.

The mineral resources of the island, so far as developed, consist almost entirely of hematite iron ore, which has been mined for many years at the south base of the Sierra Maestra, a few miles east of Santiago. Nearly all the ore, which contains about 62 per cent of iron, is shipped to the United States. Copper, gold, and silver were mined formerly. Asphaltum has been found in several places, particularly near the city of Santa Clara, where it has been utilized to make illuminating gas.

The climate of Cuba is comparatively simple. The northeast trade winds bring an ample rainfall, about 52 inches, to the northern slopes of the island, between May and October; the rainfall on the southern slopes is less, but sufficient for most crops. The mean annual temperature at Havana is 77 deg. The higher temperature lasts a long time, but on the northern slopes of the island the nights, even in summer, are cool.

The six provinces, from west to east, Pinar del Rio, Havana, Matanzas, Santa Clara, Puerto Principe, Santiago, are divided into 132 municipal districts, or *terminos municipales*, including the Isle of Pines, and are subdivided into about 1,500 barrios, including those constituting the cities. Cities, as organized in our sense, do not exist in Cuba. Havana has no legal limits, but comprises most of the municipal district of that name.

Columbus landed at Nuevitas on the north coast of Puerto Principe on October 28, 1492. In 1512 Velasquez, with 300 men, founded the town of Barracoa near the eastern end of the island, and two years later Santiago and Trinidad, both on the southern coast. Havana was founded in 1519 and became the capital in 1552. In 1775 the European population numbered 171,620. The English held Havana and a part of Matanzas for some months in 1762. Insurrections occurred in 1717, 1812, 1826, 1868, and finally in 1895, the last resulting in the relinquishment by Spain of her sovereignty to the United States on December 10, 1898.

The aboriginal inhabitants of Cuba have been estimated at from 200,000 to 1,000,000. They were enslaved, put to work, and destroyed by the European settlers long before the end of the sixteenth century. African slaves were then introduced, and the African slave trade remained a most profitable one up to the abolition of slavery in 1883.

The Spanish census of 1887 gave the population as 1,631,687; the census taken under the direction of the United States War Department in 1899 gave the population as 1,572,797, or nearly 59,000 less. Allowing for probable increase of population between 1887 and 1895, the date of the beginning of the insurrection, the loss of life due to the war, as indicated by these two censuses, may be estimated at nearly 200,000, and fell entirely upon the three western provinces, Pinar del Rio, Havana, and Matanzas. The density of population, taking the island as a whole, was 35.7 inhabitants to the square mile, and varied from 153 per square mile in Havana to 8 in Puerto Principe. The urban population of Cuba, including cities of 1,000 each, is 47.1 per cent, the same as that of the United States. As to sex, the proportions were 51.8 per cent males and 48.2 females, the excess of males being probably due to immigration. As to race, there were 68 per cent white and 32 per cent colored, and the colored population has for many years been diminishing. The foreign-born formed 9 per cent of the total population, which leaves 60 per cent as native whites. Three-fourths of the foreign-born came from Spain, the remainder chiefly from the United States, China and Africa. Nearly one-third of the foreign-born element was found in Havana. The proportion of those married was 24 per cent of the population, and of this proportion about two-thirds were legally married and one-third were living together without marriage. The legally married constituted only about one-half the proportion to the population that they do in the United

States. Of the total population, 34 per cent were able to read, illiteracy being greater among the colored than among the whites, and greater in the rural districts than in the cities. The number of Cubans reported as having gainful occupations was 40 per cent of the total population, a larger percentage than in either the United States or in Porto Rico. Of the males, 68 per cent were wage-earners; of the females, 9 per cent. Of the wage-earners, 48 per cent were employed in agriculture, fisheries, and mining; 23 per cent in domestic and personal service; 15 per cent in manufactories; 13 per cent in trade and transportation; and 1 per cent in the professions.

There were, in 1899, 60,711 farms, having an average size of 143 acres, and an average cultivated area per farm of 13 acres. Only 10 per cent of the farm area and only 3 per cent of the total area of the island was under cultivation. Matanzas and Havana provinces are the most highly cultivated parts of the island. Of the cultivated area, less than 50 per cent was owned by its occupants, the rest being rented; and 85 per cent was occupied by whites, as owners or renters, only 11 per cent by colored, the remainder being unknown. Measured by the areas under cultivation, sugar cane occupied 47 per cent of the cultivated lands; sweet potatoes, 11 per cent; tobacco, 9 per cent; bananas, a little less than 9 per cent; and other crops in smaller proportions. Santa Clara and Matanzas produced nearly three-fourths of the sugar crop, Santiago about one-sixth, and Havana about one-sixteenth. Three-fourths of the entire tobacco crop came from Pinar del Rio, and nearly all the remainder from Havana and Santa Clara provinces. There were in Cuba, in 1899, 207 sugar mills, or centrals, producing daily 61,407 bags of sugar. There were also 85 stills, with a daily capacity of 161,751 gallons. Coffee was once an important Cuban product; but little is now produced, that little coming from the provinces of Santiago and Santa Clara.

The Gazetteer is illustrated by map and plates showing distribution of population and products.

The Gazetteer proper consists of about one hundred pages of names of localities, streams, mountains, civil divisions, etc., with appropriate descriptions and definitions, as may be illustrated by the following: "Havana: the capital and chief city of Cuba. It is situated upon the western shore of Havana Harbor, one of those curious pouch-shaped harbors so common upon the Cuban coast. The population in 1899 was 235,981, making it by far the largest city of the island. Of the population, males are in excess to the extent of 5 per cent. As to race and nativity, 49 per cent, or a trifle less than one-half, are native whites. The proportion of foreign-born was no less than 22 per cent, while that of colored was 28 per cent. The foreign-born were composed in a large proportion of persons of Spanish blood. The water supply of Havana is derived from the springs of Vento, 9 miles distant, the water being brought to the city by aqueduct."

NOTES ON THE MOUNTAIN SHEEP OF NORTH AMERICA, WITH A DESCRIPTION OF A NEW SPECIES.*

By WILLIAM T. HORNADAY.†

To many American sportsmen and naturalists there is no other wild animal on this continent which challenges admiration equal to that bestowed upon the mountain sheep. Unfortunately, it is only those who have made the acquaintance of this animal in life, and upon its own ground, who have a fair conception of its character. Neither from the best mounted museum specimens, nor from the best living examples that have been shown in zoological gardens, can the observer learn the true character of this hardy mountaineer, in whose anatomy strength is combined with agility to an extent which is nothing short of marvelous. Its home is the loftiest rim-rock of the high mountain plateaus, or the most rugged and forbidding bad-lands of the middle altitudes. In summer its favorite pastures are the treeless slopes above timberline, and in winter it paws through the snows of the mountain meadows to reach the tallest spear of grass. When the raging storms and deep snows of winter drive the elk and deer down into the valleys for food and shelter, the mountain sheep makes no perceptible change of locality. All the year round this animal is both well fed and well clad, and its savory flesh invites constant pursuit and attack from the mountain lions, and hunters both white and red. Unlike its dull-witted neighbor, the mountain goat, the mountain sheep is wide-eyed and wary, and difficult to approach.

The best known species of mountain sheep of North America is the familiar big-horn of the Rocky Mountains (*Ovis montana*), which has been known for more than a century.

In 1884 the pure white mountain sheep of Alaska and northwestern Canada was described by E. W. Nelson, and christened *Ovis dalli*, in honor of Prof. William H. Dall, of Washington, D. C. Next in order of discovery came Nelson's mountain sheep (*Ovis nelsoni*), of southern California, described by Dr. C. Hart Merriam in 1897. In 1896, while on an exploring expedition in the Cassiar Mountains, of northern British Columbia, Mr. A. J. Stone discovered the very interesting dark-colored species of mountain sheep described by Dr. J. A. Allen in 1897, and christened *Ovis stonei*, in honor of its discoverer.

The discovery of gold on the Klondike River, Northwest Territory, has led to the discovery of still another species of mountain sheep, which may justly be regarded as the handsomest and the most striking in color markings of all known species of the genus *Ovis*.

While in Victoria, British Columbia, last November, the attention of the writer was called by Mr. John Fannin to the skin and skull of a mountain sheep which had been sent down from Dawson City by Mr. Henry W. Brown, as a specimen of *Ovis stonei*, and presented by him to the Provincial Museum. An examination of the skin, which is not only from an adult male animal, but is also in perfect pelage and preservation, revealed the startling fact that it represents a species absolutely new to science, and so strikingly differentiated as to render its title to independent specific rank beyond question. It is hereby described and named in honor of Mr. John Fannin, Curator of the Provincial Museum of British Columbia, in recognition of his work as a naturalist specially interested in the animal life of the Northwest.

OVIS FANNINI, SP. NOV.

FANNIN'S MOUNTAIN SHEEP: ALSO, "SADDLE-BACKED" SHEEP, OR "PIE-BALD" SHEEP.

Type Collected by Mr. Henry W. Brown at Dawson City, N. W. T., February, 1900, and presented to the Provincial Museum, Victoria, B. C.

Description of an adult male, nine years old, killed in midwinter.

Colors.—Entire head and neck, breast, abdomen, inside of forelegs, and rump patch for four inches above insertion of tail, snow white. Entire body, except as above, brownish gray, giving the appearance of a white animal covered by a gray blanket. This color is produced by a nearly even mixture of pure white and blackish-brown hairs. The gray color covers the shoulders from the insertion of the neck downward to the knee, where it fades out. On the outside of the thigh, the gray color grows paler as it descends, until at the hock joint it fades out entirely. The posterior edge of the thigh is white. The lower portion of the inner surface of the thigh partakes of the gray body color, but is somewhat paler.

On the front edge of the thigh, and extending down to the hoof, is a conspicuous band of dark brown, 1½ inches wide, which, below the hock joint, joins rather abruptly the pure white hair which covers the sides and rear edge of the leg. A similar brown band extends down the front of the foreleg, from knee to hoof, similarly backed up posteriorly with white.

The tail is similar in color to the body, but much darker, and a thin line of dark brown hair connects it with the gray mass of the body. The white rump patch is similar in form to that of *Ovis montana*, but covers a smaller area.

Pelage.—Thick and long; finer and softer than on *Ovis montana*. On the neck and abdomen it inclines to shagginess, like that of the mountain goat. The stiff, brittle quality is noticeably absent from all white parts of the animal. Everywhere the pelage is abundant and thick, as befits an Arctic animal. Because of this the animal appears to be shorter in the legs and more stockily built than all other American species, save *Ovis dalli*.

Length of hair on top of neck, 4½ to 5 inches; basal half, stiff, crimped; terminal half, fine, straight, rather soft. One inch of thin, fine wool next to skin.

Length of hair on throat and lower neck, 3½ inches.

Length of hair on middle of side, 2½ to 3 inches; fully crimped stiff; trace of fine wool at base.

Length of hair on inner surface of thigh, 3 inches; straight, fine, rather soft.

Length of hair on abdomen, 2½ inches; rather fine and straight.

Length of hair on tail, upper surface, 3 inches; straight, coarse, stiff.

Horns.—In color, clear, transparent, even amber-like, similar to the horns of *Ovis dalli* when clean. Annulations numerous and well defined. A slight groove under the superior angle, not so deep as that of *Ovis stonei*. In the type specimen the horns do not spread as in *Ovis stonei* and *dalli;* but this character is of little scientific value, because of the wide variations between individuals of the same species.

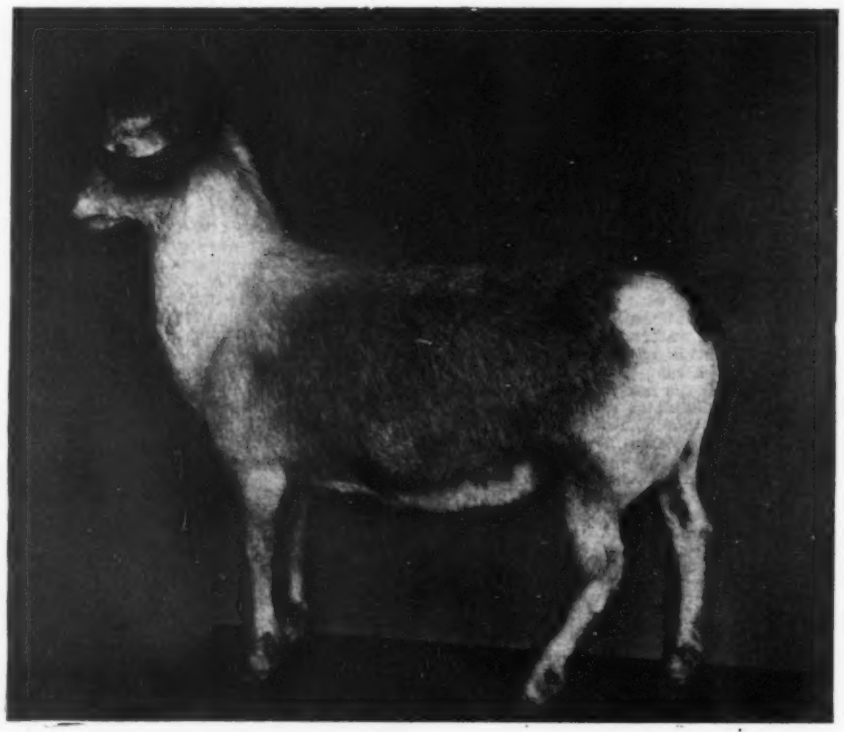
Measurements of Horns.

	Inches.	Cent.
Circumference of right horn at base	13½	34.4
Length on outer curve	40½	103
Greatest spread (at rear)	21½	54.6
Distance between points	20	50.9
Distance between lowest angles, across forehead	4½	11.5

General Measurements.—The following measurements were derived from the soft skin, by taxidermic methods of long usage:

	Inches.	Cent.
Height at the shoulders	34	86.5
Length of head and body	60	152.5
Girth behind foreleg	38	96.5
Head, from angle of nostril to inner angle of eye	6½	16.6
Head, from end of nose to base of ear	13	33
Width between orbits	5	12.65
Height of ear	3½	9
Front hoof, 2¾ inches long by 2½ inches wide.		
Rear hoof, 2½ inches long by 2 inches wide.		
Tail, length to end of vertebræ	4	10.2
Tail, length to end of hair	6½	16.6

Distribution.—The points of difference between *Ovis fannini* and all other species of American *Ovidæ* are conspicuous, and it is remarkable that an animal so large and handsome, and so strangely marked that its separate identity must be recognizable at a considerable distance, should remain in North America undiscovered, and even unheard-of, until the closing year of the nineteenth century. It is strange, indeed, that for so many years it has escaped the vigilant eyes of the Hudson Bay Fur Company and its grand army of hunters and trappers.



FANNIN'S MOUNTAIN SHEEP (*OVIS FANNINI*).
Mounted by John Fannin, Provincial Museum, Victoria, B. C.

Concerning the precise range and abundance of this animal, Mr. Brown has written me, under date of December 20, 1900, as follows:

"From the summits of the low mountains about Dawson, on the east side of the Yukon, can be distinctly seen, about fifty to seventy-five miles to the eastward, a beautiful, long, rugged, snow-capped mountain range, extending in a northerly and southerly direction away beyond the view, known as the Rocky Mountains. The two main branches of the Klondike River head in those snowy mountains, in a southeasterly direction from Dawson, and I understand it is there the mountain sheep are found by the hunters. As to how numerous they are I do not know, but presume they are quite plentiful, as I have seen several sled loads of the frozen carcass brought in by hunters to sell to the Dawson markets.

"There are two species, one being all white; the other, such as the specimen you saw, is white with gray saddle-back. The white species, so far as I saw, are a little the smallest."

Mr. Warburton Pike, the Arctic explorer, informed me that on his journey down the Yukon, a short distance below Dawson, he heard of a "pie-bald" mountain sheep, but was unable to procure a specimen. It is highly probable that *Ovis fannini* will be found distributed throughout a considerable extent of the rugged mountain ranges which quite surround Dawson City north of the Yukon.

Inquiries that have been made of Alaskan and Northwest Territory travelers and authorities have elicited several interesting statements bearing on the existence of *Ovis fannini*. The most direct and positive is that of Mr. C. J. Jones, the well-known breeder of buffaloes,

* The description of Fannin's mountain sheep, reprinted herewith, was read before the New York Zoological Society at its annual meeting on January 8, 1901, and published on that date as an appendix to the Society's Fifth Annual Report. The preparation of the accompanying notes has been prompted by the fact that the literature of the subject was so meager and so widely scattered that to the average student a comprehensive view of this very interesting group of animals was unobtainable, except by great effort. Another reason for this publication is the hope that it may stimulate, and also promote, more precise and general inquiry into the life histories and distribution of the six species of American mountain sheep.

In order to bring the subject more sharply before the student, no attempt has been made to trace the early history of the big-horn, and the distribution of the various species is given only as it is believed to be today.

† From the Fifth Annual Report of the New York Zoological Society.

who in 1897-98 made a trip to the Barren Grounds after musk ox, and returned by way of the Porcupine-Yukon route. In a letter dated January 26, 1901, he says:

"There were two small bands [of mountain sheep] on the Big Black River. The members of one band were white, while the others were partly white, and a part of them were brown on the backs. I also saw the skin of a part white and part brown specimen at Yukon City."

The following statement by Mr. R. G. McConnell, of the Canadian Geological Survey, in a letter dated January 25, 1901, is equally important:

"The saddle-backed sheep described by you as *Ovis fannini* occurs in the ranges west of the Yukon, between Selkirk and Forty-Mile River, but it is not known how far it ranges beyond those limits."

An inquiry addressed to Mr. A. J. Stone elicited (January 28, 1901) the following very pertinent information in reference to *O. fannini:*

"I have passed completely around its home, and heard of it a good many times, but without getting possession of any specimens. Fearing that I might be criticised as an over-zealous advocate of new species, and fearing that the reports of 'gray sheep' were groundless, I left the matter for further developments, and I am glad that the real thing has been unearthed by you."

On March 29, at Fort Wrangel, Mr. Harry Pidgeon stated to Mr. J. Alden Loring that he saw a bunch of twenty Fannin's sheep on the cliffs of Lake La Barge. At a distance they appeared to be white, but on approaching within thirty yards he saw the gray color rusty speck. On close examination this tipping of the hair makes the fur look as though it had been slightly singed."*

In his report on his "Natural History Collections in Alaska" (p. 284), Mr. Nelson makes the following record: "All of the skins of this animal seen by me among the Eskimo from the Kuskoquim River to the Arctic coast were of the uniform dingy whitish color characteristic of the race."

Unfortunately, the coat of Dall's sheep is sometimes influenced by its surroundings in a manner which tends to convey a very erroneous impression of its real character. During the spring and summer months the hair is frequently stained and discolored by contact with wet soil when the animal lies down. Each hair is a thin, white tube, filled solidly with a spongy, white pith, which readily takes up any liquid coloring matter by capillary attraction. When the end of a hair becomes filled with rusty-yellow clay water, or water discolored by dark gray earth, the coloring matter is held there for an indefinite period. This it is which sometimes imparts to the hair of this animal the appearance of being tipped with "a dull rusty speck." It is strikingly shown in some skins in the American Museum of Natural History, collected in the month of May, and which have been examined through the courtesy of Dr. J. A. Allen. On one of these the entire pelage had been so discolored by what was probably a ferruginous clay as to turn the outer surface of the pelage, and in some places the whole depth of it, the color of iron-rust. The under surfaces of the skin were most heavily stained, and the abdomen showed large patches of this dull-reddish clay color.

STONE'S SHEEP (*OVIS STONEI*, ALLEN).

Male specimen, 7 years old, in the Field Columbian Museum, Chicago. Mounted by C. E. Akeley.

on their backs. Inasmuch as Mr. Pidgeon is an experienced mountain sheep hunter, and is known to be familiar with both Stone's sheep and Dall's sheep, his observation may fairly be regarded as conclusive respecting the existence of *Ovis fannini* at lat. 61 deg., and long. 135 deg.

Mr. Loring advises me, from Juneau, on April 10, that he has met several persons who have seen this species in the meat markets at Dawson.

OVIS DALLI, NELSON.

WHITE SHEEP: DALL'S MOUNTAIN SHEEP.

Type Specimens in the United States National Museum. Described by E. W. Nelson, in the Proceedings of the National Museum, VII., 1884, page 12, as *Ovis montana dalli.*

Type locality.—Tanana Hills, Alaska, 100 miles southwest of Fort Yukon, Alaska.

Color and Pelage.—In both sexes the pelage of *Ovis dalli*, when clean, is everywhere milk-white, both in winter and in summer, and from birth to old age.

Through a strange combination of circumstances the type specimens collected in the Tanana Hills, far in the interior of Alaska, were of such a peculiar appearance that Mr. Nelson could not possibly do otherwise than describe them as being "nearly uniform dirty-white. The dinginess of the white over the entire body and limbs appears to be almost entirely due to the ends of the hair being commonly tipped with a dull

Regarding the color of *Ovis dalli*, the statements of two scientific collectors, Prof. Lewis Lindsay Dyche and Mr. Andrew J. Stone, will be quoted in full in these notes.

For fifteen years the strangely discolored type specimens of *Ovis dalli* have conveyed to zoologists a totally erroneous impression of the true color of this beautiful animal; and for nearly that length of time they have remained unique in their peculiar appearance. At last, two other singed-looking specimens have been noted. On his journey down the Yukon, in 1896, Mr. Warburton Pike saw some mountain sheep skins at the mouth of Forty-Mile Creek (forty miles below Dawson City), which he describes as being "very white, with the tips of the hair looking as if they had been singed by fire."

I have examined perhaps forty skins and heads of this animal, and, excepting the type specimens, have never seen even one that was otherwise than clear milk-white, save a few which had become stained or dirty through contact with earth or dust. There is now before me a mounted head, taken in summer, the hair on which is only an inch in length, but it is perfectly white and immaculate. To show the very striking effect of this animal as seen alive in its own haunts, Messrs. W. R. McFadden & Son, of Denver, very kindly took the trouble to transport three specimens, owned and recently mounted by them, to a rocky situation near Denver, and there had them photographed for reproduction in these notes.

The hair on all these specimens is pure white, and there is no trace of any coloring matter at the ends of the hair.

Let anyone who doubts the purity of color of *Ovis dalli* examine two surpassingly fine unmounted skins in the collection of the United States Biological Survey, at Washington, Dr. C. Hart Merriam, Chief, which were collected on the Porcupine River, Alaska, eighty miles northwest of Rampart House, on January 25, 1894, by Gen. Frederick Funston. For luxuriance of pelage I have never seen their equal. The hair of the male measures as follows:

	Inches.	Cent.
Length on top of neck	6	15.3
Length on shoulders	5	12.8
Length on side	3	7.7
Length on thigh	3½	9

The long hair on the top of the neck is finely pointed, not crimped throughout its terminal half, and is so luxuriant that it forms a semi-erect mane, like that of the mountain goat, which extends quite over the shoulders. The tip of the tail of each of these animals bears a very small bunch of dark-brown hair, and about two-score of long, brown-tipped hairs are scattered through the coat of the ram, on the hindquarters.

The full winter coat of *Ovis dalli* is long and thick, and softer than on *Ovis montana*. On the neck, shoulders, and abdomen it is so abundant it may properly be called shaggy. Because of the greater abundance and length of its pelage this animal seems very stockily built, but this is not the case. In midsummer it is as clean-limbed and shapely as an antelope. A noticeable peculiarity of the midwinter pelage is the length and fineness of the hair on the neck, which is quite unlike that on the big-horn.

The old hair begins to fall off in May, and by the end of June has almost entirely disappeared. The transformation is as great as the shearing of a domestic sheep. Owing to the extreme shortness of the new hair, it seems to be more stiff and coarse than afterward, when it attains its full length. In comparison with other species, the pelage of *Ovis dalli* resembles that of *fannini*, while the coat of Stone's sheep is more like that of the big-horn.

Fortunately for all these animals, their hair is so brittle and so easily broken, their skins possess little value to mankind, although they are often put to use by the natives as clothing and robes. Had nature seen fit to clothe the wild sheep like the best of the fur-bearing animals it is extremely probable that very few specimens would now be alive on this continent.

Horns.—The most strongly characteristic features of the horns of *Ovis dalli* are two in number—(1) the front and rear side grooves, caused by the overhang of the upper surface of the horn, and (2) their light color.

In fresh specimens the horns have a pale yellow, semi-transparent appearance, strongly suggestive of amber. From specimens that have been kept for a considerable period, and from which the natural oil of the horn has dried up, this amber-like appearance disappears, and thereafter the color is much the same as in the horns of *Ovis montana.*

The horns do not spread widely, as in *Ovis stonei*, but they possess a peculiarity which is not found in any other American *Ovis*. The top of the horn is wider than its central transverse diameter; and, midway between the two ends, the upper surface overhangs both sides in two pronounced ridges. The ridge on the rear, or inferior, angle overhangs most strongly, as will be seen in a cross sectional diagram, and gives the horn the appearance of being strongly grooved on both sides. The rear groove, however, disappears entirely about six inches from the skull. The largest horns of this species do not possess more than about one-half the bulk of the largest horns of *Ovis montana*, but they are much more handsomely modeled, and are rarely broken or "broomed" at the tip. I have never seen a notably imperfect pair.

The horns of the white sheep are frequently made into large, long-handled spoons or soup ladles, which find their way all over Alaska to Point Barrow.

General Notes.—The fact that for a hundred years prior to 1884, both Russians and Americans had explored the coast of Alaska without discovering the presence of this snow-white mountain sheep is its own commentary on the perceptive faculties of mankind generally in the Northwest. Had the animal inhabited only the mountain fastnesses of the remote and difficult interior, its immunity from discovery would be easily explained; but in many localities it inhabited ranges washed by tide-water, and lived almost within sight of the traders along the coast.

It was not until 1884 that the white sheep was discovered and described in print by Mr. E. W. Nelson, a trained naturalist in the service of the United States government. Strangely, and unfortunately, his type specimens were so dingy and off-color from pure white that he was compelled to describe the species as being "nearly uniform dirty-white," which was ascribed to "the ends of the hairs being commonly tipped with a dull, rusty speck." Whatever may have been the cause of this peculiar condition of the pelage of the skins on which *Ovis dalli* was based, their color certainly was peculiar to them.

A very convincing explanation of the condition of some skins of white mountain sheep, which might be described as "dirty white," is found in the following interesting statement furnished me on this point by Prof. Lewis Lindsay Dyche, of the University of Kansas, based on extensive personal observations in the Alaskan Mountains:

"The white mountain sheep are a 'dingy or dirty-white' during the summer season only. This is particularly true during the months of July and August. By the first of July the animals have shed their long, thick coats of winter hair. At this time they are almost naked, so to speak, the hair being not more than from ¼ to ½ inch in length. The animals frequent the sunny sides of the mountain ranges, and make their beds in masses of shale rock, or on slopes where there is more or less dirt. They frequently paw the rocks and earth away so as to make a form large enough to sleep in. These places become more or less covered with droppings. Light snows and rains come,

* Proceedings of the National Museum, 1884, p. 12.

the earth is damp, and the animals get their hair stained until they become a 'dingy or dirty-white.' By the first of September the snows are falling, and the animals have a fair coat of hair. They make their beds in the snow, and gradually become white. I saw skins that were white. The ones I got early in September were nearly white, but not beautiful and snow-white like those taken late in the fall and early winter. Pure white skins in the bands of the Indians soon become soiled, and dingy with smoke."

In the course of his very extensive Arctic and sub-Arctic explorations, Mr. Andrew J. Stone has enjoyed exceptional advantages for observing the white sheep in its haunts. The following statement from him regarding the color of this animal is therefore of decided interest and value:

"I have taken specimens of *Ovis dalli* in the Nahanna Mountains, a spur of the Rockies about 60 deg. north, and in the main range of the Rockies at 66 deg. 30 m. north. I have seen specimens at the mouth of Arctic Red River, and at Fort McPherson, on the Peel River, from near the head-waters of these streams. I have also seen numerous specimens from the Rockies where they form the divide between the lower Peel and the Mackenzie delta on the east and the waters of the Porcupine on the west, and also from the Rockies that extend farther west along the Arctic coast.

"In the fall and winter of 1900 I saw a considerable number of specimens on the Kenai Peninsula.

"The only colored hairs I ever observed on any of the specimens of *dalli* I have seen were on a specimen I took in the Nahanna Mountains. On the end of the tail were about a dozen brown hairs. The appearance of the pelage of specimens from different sections, taken at the same time of the year, was very much alike. The summer coat acquires a rusty hue, which in all probability is due to coloring in the soil and beds of decomposed shale, where the sheep so frequently lie down. Winter specimens appear to be quite free from this stain, exhibiting, so far as I have ever observed, a clear white coat."

The white mountain sheep is noticeably smaller than the big-horn, and its more ample pelage has the effect of making it seem short in the legs and heavy in the body. The face averages between one and two inches shorter than that of the big-horn, of the same age. The horns are much more slender and more delicately modeled than those of *Ovis montana*, and by them alone this species can readily be distinguished from all others. Their closest resemblance is to the horns of *Ovis nivicola*, of Kamschatka.

During the last five years, explorations in Alaska and the Northwest Territory have greatly extended the known range of this species. Indeed, it would not be surprising if the complete exploration of the Northwest reveals the fact that the white sheep inhabits every important mountain range north of the 60th parallel and west of the Mackenzie River. Whether it has ever crossed the Mackenzie delta, and spread through the mountains that extend eastward along the coast, remains to be determined; but it is entirely probable that it has done so. The gap (if one there be) between the low mountains immediately eastward of the delta and the high range extending southeastward from Cape Bathurst can be no greater than the eastward wanderings of the big-horn from the Rocky Mountains, along both the Yellowstone and the Missouri rivers.

The localities of the white sheep which are most accessible to American sportsmen and naturalists are the mountains of the Kenai Peninsula and the Alaskan range surrounding Cook's Inlet.

Up to this date it cannot be learned that a specimen of *Ovis dalli* ever has been captured alive and kept in captivity. Certainly none have ever reached any of the zoological gardens of either America or Europe. However, the acquisition of living specimens is only a question of effort and expense. Whether the species can be induced to live outside of Alaska remains to be seen, but in any event its acclimatization is likely to be a matter of considerable difficulty. There is reason to hope, however, that specimens taken from a comparatively low altitude on the coast of Alaska may live in the climate of New York longer than big-horn from the high, dry, and rarefied atmosphere of our Rocky Mountains.

So far as I am aware, the honor of being the first person to photograph living wild specimens of white sheep in their mountain homes belongs to Mr. Harry E. Lee, of Chicago. As a contribution to these notes, Mr. Lee has generously extended to the Society the privilege of reproducing two of his pictures, hitherto unpublished, of living sheep, which are valuable representations both of the species and its home. The difficulties that have been surmounted in securing these plates surely will be appreciated by every hunter and collecting naturalist.

Ovis Stonei, Allen.

Stone's Mountain Sheep: "Black Sheep."

Type Specimens in the American Museum of Natural History, New York City. Collected by Andrew J. Stone, 1896.

Type locality.—Northern, British Columbia, Cheonnee Mountains, headwaters of the Stickine and Nass rivers. Lat. 57 deg. to 58 deg.

Description.—This animal is smaller and more lightly built than *Ovis montana*. Its pelage is compact, and not so abundant as in *Ovis dalli* and *fannini*, and lightest in color when immature. After the third year it is readily distinguished by its dark colors, gray and dark brown, by a nearly black dorsal stripe extending from the back of the head to the tip of the tail, and the wide spread of its horns.

Lamb.—Variable in color. Sometimes quite similar to the lamb of *Ovis montana* of the same age, and again much lighter. A lamb in the American Museum of Natural History, twenty-five inches high at the shoulders, is light gray. On the head, neck, and shoulders, to the region behind the elbow, the color is almost as light as the rump patch and inside of thighs. The breast and region of the shoulder joint and humerus are a shade darker, as also are the loins, iliac region, and thighs outside. The dorsal stripe is conspicuous and sharply defined. The horns are only one inch in length.

A lamb of the same age in the Field Columbian Museum is everywhere very much darker, save its rump patch, and, taken alone, might easily be mistaken for a young specimen of *Ovis montana*.

Male and female, up to third year.—From the first year the color gradually grows stronger and darker until full maturity is reached.

Male, fourth year.—Decidedly darker in all its dark colors, and the rump patch is lighter.* The head has remained unchanged, as to lightness of its color, from the first year. The body color of old males is Vandyke brown, with a slight mixture of gray hairs; but at a little distance the animal appears to be dark brown, or blackish brown. The body color is darkest low down on the sides, where it meets the white area of the abdomen, and is nearly black.

The face is distinctly lighter in color than the body, the end of the muzzle being of a dirty, or dusky, white. The top of the muzzle is a warm, browned gray, and the forehead is the same. Below the eyes is a large patch of a lighter color. Behind the horns, on the occiput, is a conspicuous dark patch from which an almost black band, 1½ inches wide, extends back to the shoulders. Between this and the lower half of the neck the hair has, in some specimens, a rusty yellow wash, which consists of many yellow-tipped white hairs slightly mixed with brown. The lower surface of the neck is colored like the back and sides, but is darker where it joins the body. This color is continued over the breast to a point about six inches back of the forelegs, where it is sharply divided by the apex of a broad triangular rear area of white. This white tract covers the abdomen up to the flanks, the space between the thighs, and extends on upward until it terminates high up on the hindquarters in a rump patch similar to that of *Ovis montana*. In this light-colored rump patch the tail appears as a diamond-shaped patch of blackish-brown hair. The darkest portions of this animal are behind the forelegs on the outside of the forearm, and on the outside of the thigh from the hock joint upward. The front edges of the legs are dark colored, while the rear edges are light, and a light-colored band extends centrally up the inside of the thigh.

Pelage.—On summer specimens the pelage is short and compact, and the animal has a very trim and neat appearance. Of the specimens that have been collected up to this date, sixteen have been examined by the writer, and upon all the pelage is stiff and coarse. The long, fine, and abundant hair of the neck and abdomen of *Ovis fannini* is conspicuously absent, a fact which is only partly accounted for by the season in which the specimens were collected.

Horns.—The wide-spreading, deeply grooved horns of *Ovis stonei* are one of the most prominent characters of this species. The horns are light in color, slender, and deeply annulated near the head. Their most prominent mark is a deep groove under the superior edge, a quarter of an inch deep for the first seven inches out from the base, but usually disappearing entirely about eleven inches out. The back of the horn, at the middle, is almost flat.

Measurements.—Of actual measurements of *Ovis stonei* in the flesh, none are available for adult males, those taken by Mr. Stone having, unfortunately, been mislaid beyond recovery. Regarding the size of this animal, however, Mr. Stone has furnished me with the following statement: "The sizes of *Ovis stonei* and *O. dalli* are identical; there is no precéptible variation between the sizes of the two species. I know this from actual measurements." Regarding specimens of other ages, Mr. Stone has kindly supplied the following records of measurements made by him:

General measurements of adult female *Ovis stonei*.

	Inches.	Cent.
Height at shoulders	32	81.4
Total length	52	132.4
Height at elbow	20¼	51.5
Depth of body	13¾	35
Femur to humerus	32½	82.6
Tarsus	15	38.2
Tail	3	7.7
Across the chest	8	20.4

Two-year-old male *Ovis stonei*.

	Inches.	Cent.
Height at shoulders	29¾	75.7
Total length	49	127.7
Height at elbow	18	45.9
Depth of body	13	33.1
Femur to humerus	28½	72.5
Tarsus	14	35.7
Tail	2¾	
Across the chest	7	

Measurements of the head of a six-year-old ram mounted by Lindley & Foster, Victoria, B. C.

	Inches.	Cent.
Circumference of horn at base	14.25	36.3
Length on outer curve	32.50	82.6
Extreme width, between points	28.75	73.1
Inner corner of eye to nostril	6	15.4
Width between lower angle of horn ridges	5.50	14
Length, base of horn to end of nose	8.50	21.6
Circumference of muzzle	8.50	21.6

The strongly marked species of mountain sheep which now bears the name of *Ovis stonei* was discovered in the Cheonnee Mountains of northern British Columbia, at the head-waters of the Stickine and Nass rivers, in the summer of 1896, by Mr. Andrew J. Stone, in whose honor the species was named. It inhabited an elevation of 6,500 feet, which is about 4,000 feet above timber line. Three of the specimens collected were mounted in Missoula, Mont., and exhibited at the New York Sportsmen's Show in the winter of 1897, where they were at once recognized as representing a species up to that time unknown. The specimens were purchased by the American Museum of Natural History, and described by Dr. J. A. Allen in the Bulletin of that institution, vol. ix., pp. 111-114, pl. 2, on April 8, 1897.

Thus far nothing positive is known of the geographic range of the black sheep save the facts that have been furnished by Mr. Stone himself. On this point he makes the following statement:*

"The range of *Ovis stonei* extends throughout the Cassiar Mountains, and in the Rocky Mountains, east of the Cassiar, north to where Beaver River, a tributary of Liard River from the north and west, breaks through the Rockies near latitude 60 deg. I believe that the Rocky Mountain divide, between the head-waters of the Peace River and those of the Fraser River, forms the dividing line between its range and that of the southern *Ovis cervina*. Its western limit very nearly conforms to the Cassiar Mountains and their numerous spurs."

In 1896, Mr. Warburton Pike, while journeying down the Yukon River, saw at Hoole Canon, on the Pelly River, near Pelly Mountains, two skins and heads of mountain sheep, which he has described as follows:†

"The horns were exactly like those of the big-horn of more southern latitudes, and the skin gave no signs of the gradation of color known to exist between the true *Ovis montana* and the *Ovis dalli* of the northern mountains."

This interesting observation is capable of but two interpretations: (1) the specimens seen were *Ovis montana*, which thereby makes a long leap northward, from lat. 55 deg. to 61 deg. 45 m., about 650 miles; or, (2) they were *Ovis stonei*, either weathered or slightly immature specimens, which in either case would very closely resemble the dark British Columbia phase of *Ovis montana*. Mr. Stone himself is authority for the range of his black sheep up to lat. 60 deg., within ninety miles of Hoole Canon. It is my belief that the specimens seen by Mr. Pike were really immature *Ovis stonei*, and mark the most northerly limit yet recorded for that species.

In this connection it is worth while to note that, up to this date, there has been no record of the presence of both the black sheep and white sheep in the same locality, nor of any mixing of either of these with the big-horn.

* Between the type specimens in the American Museum at New York and those composing the very fine group in the Field Columbian Museum at Chicago, there is a marked difference in intensity of color. The former are all much lighter than the very brown and somber Chicago specimens. Mr. Stone is of the opinion that the New York specimens more nearly represent the average color of this species. The difference is no greater, however, than is sometimes observed in *Ovis montana*, but the cause of it remains a mystery.

BITUMINOUS CUPRIC SULPHATE FOR THE VINE.‡

A remedy has been discovered which gives excellent results. It combats several maladies at once and is not costly. On seeing its chemical composition, there is no need of being a distinguished agriculturist, chemist or professor, to understand that it must be both an insecticide and a fertilizer. This is bituminous cupric sulphate, of which the composition is the following:

Pure native sulphur, 15 to 20 per cent.
Peroxide of iron, 3 per cent.
Schist, bitumen, or oleaginous gas products, 10 to 12 per cent.
Silicate and carbonate of magnesia, 18 to 20 per cent.
Sulphate of copper, 5 or 6 per cent.

The inventor has used this preparation for a considerable time with splendid results. In order to convince the most incredulous, he recently invited many French and foreign vine cultivators to inspect his vineyard. He has had hundreds of visitors, and all have been convinced.

The vineyard is situated at Chaux near Nuits (Cote d'Or). The vine dressers are MM. Tillet, father and son. Inquiry may be directed to them, or to the mayor, curate, teacher, or any other resident of the vicinity, as to the remedy applied, and the results attained.

This remedy is also a protection against spring frosts. As soon as the buds swell they are sprinkled. The preparation is adherent and forms a dusty coating, which absorbs the excess of moisture, and is a protection against the direct action of the solar rays at this period, as well as against the frost.

The inventor recommends to cultivators the use of the remedy as prescribed. The ingredients can be procured of the grocer or the druggist; the mixture can be compounded for them if they prefer. But they should avoid sulphurs prepared under different names, such as triturated, sublimated, bituminous, etc., which are not complete for the purpose and yield poor results.

PERMANGANATE OF POTASH FOR THE VINE.§

Since the remarkable experiments of M. Charles Truchot, instituted first in the years 1893 and 1894, the employment of potassium permanganate for the cryptogamous maladies of the vine, has attracted more and more attention among advanced cultivators. At the outset, the experiments attempted in Haute-Garonne, either with simple or compound solutions, were not attended with the wished-for success. On their renewal in 1898 and 1899, he obtained on mildewed Othellos such favorable results that his views on the virtues of this remedy have become a fixed religion.

This chemical product is known to have antiseptic and antimicrobic properties that are particularly energetic.

The solution M. Truchot now uses is composed of 125 grammes of potassium permanganate, 3 kilogrammes of lime and 100 liters of water. The mixture should be prepared in earthen or metallic receivers. It is applied with a sprayer, and rather slowly. The vines should not be inundated. To leave a coating, the quantity is doubled. The treatment is also advantageous in preventing too hasty a growth.

In proportion as the reaction occurs, the solution changes color, passing from violet to brown. After complete evaporation only brown traces are found on the leaves and fruit. These are quite characteristic and are seen a long time.

Tests, according to the method of M. Truchot, have not yet been widely extended, and have been made chiefly for oidium and mildew. Its efficacy may, therefore, not be considered as sufficiently demonstrat-

* Bulletin A. M. N. H., xiii., p. 42. 1900.

† "Through the Sub-Arctic Forest." 1896, p. 199.

‡ From the French of M. Auguste Desplantes in the Bulletin of the Comice Agricole de Chalons-sur-Marne.

§ From the French of M. Coudere-Mineral. Brief Summary of his Report to the French Agricultural Society.

ed for all the maladies of the vine, but there are grounds for the supposition.

Therefore, before full endorsement in general by the Society, new experiments shall be undertaken, not only for oidium and mildew, but for black rot and the other cryptogamous maladies and should be extended to further varieties of grapes.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

The East Indian Papaya.—The papaya tree flourishes all over tropical India, from Delhi to Ceylon. Its fruit is greatly prized by both European and native, as well for its edible as for its medicinal qualities.

Botanically, it is of the passion-flower family and is termed *Carica papaya*, having been once erroneously supposed to have had its origin in the Asia Minor province of Caria. In the Malay language, in most of the vernaculars of India, and in the Latin-speaking countries of America it is called papaya. In the United States it is known as the papaw or pawpaw and wrongly identified with the small tree and fruit of that name, which is of the custard-apple family, and is found growing in the Middle, Western and Southern States. According to modern botanists, the papaya is domesticated in India, and is doubtless a native of the shores of the Gulf of Mexico, whence it was introduced into India by the Portuguese at an early date or soon after the discovery of America. In the Burmese language its name means "fruit brought by sea-going vessels." The theory that it is of non-Asiatic origin is substantiated by the facts that it was not known in the East before the discovery of America, by its not having a Sanskrit name, and by the modern Indian name being evidently derived from the American word papaya, itself a corruption of the Carib *ababai*.

The tree grows very quickly and bears fruit within a year from first putting down the seed. It bears fruit all the year round and in great numbers. I have counted as many as 140 on a young tree less than two years old in my compound. It seems to thrive best in a hot, moist climate. It seldom grows more than 25 feet in height and 1 foot in diameter at the base, almost branchless, with smooth trunk, marked by the scar left by the fall of the leafstock, gradually tapering upward, bearing at the top a crown of long-petioled leaves, on footstalks 2 feet long. The leaves are deeply cut into seven irregular lobes, which give the tree much the appearance of a palm. The wood is spongy and fibrous, and of no value as timber.

The yellowish-white flowers are dioecious, having the pistels of the flower on one tree and the stamens of the flower on the other. The flower of the fruit-bearing tree is close in the axils of the footstalk or in the angle formed by the leafstock and the tree, while the flower of the non-bearing tree is in long compound racemes and is one of the few flowers of India that give a perfume, which is not unlike the odor of the orange blossom. One is called the female and the other the male tree.

Perhaps in all the vegetable kingdom there is no other plant or tree that so well illustrates the sexual system of plant life. In order that the female tree may bear and ripen its fruit, repeated experiments have shown the necessity of the male tree being so situated as to insure the influence of its flowers on those of the female and render them fertile.

The Fruit.—The fruit when ripe attains the size of a small melon, which it somewhat resembles. While growing it has a deep-green color, which on ripening turns to a dull orange. The interior is soft, yellowish and sweet, and contains numerous small, black seeds arranged in five longitudinal lines along the center cavity. They have a pleasant pungent taste, not unlike mustard seed. The ripe fruit has a flavor peculiar to itself. It is eaten by all classes and is considered wholesome. In the West Indies it is sometimes boiled and eaten as a vegetable. In India, when green, it is cooked by the natives in their curries and is also pickled. It is usually, however, eaten raw, when ripe, with salt, and is ranked among the finest of Eastern fruits.

Chemical and Medicinal Qualities.—The properties of this tree, to which I wish to draw particular attention, are its remarkable chemical and medicinal qualities. Many of them are known to the profession in America, but they are more especially known to the native Hindoo, who, in his unique village life, has extracted from the vegetable kingdom many of its valuable secrets.

The Juice.—The fruit, particularly in the early stages, secretes a white, milky, viscid juice of the consistency of cream, which has the extraordinary property of hastening the decay of muscular fiber exposed to its influence.

It has an energetic action upon nitrogenous substances and, like pepsin, will curdle milk; it is more efficacious in dissolving albumen than pepsin.

Papain.—The active principle has been separated and given the name of papain, and is used for medical purposes. This active principle, so analogous to pepsin in its physiological properties, may be obtained by adding alcohol to the juice of the unripe fruit, which causes a precipitate, which, when dried and powdered, is ready for use and called papain. The whole tree abounds in this juice, which is remarkable as containing fibrine, a principle otherwise found only in the animal kingdom. The celebrated chemist Vauquelin compared this creamy juice to blood deprived of its coloring matter. The resemblance between this juice and blood is indeed striking.

In its peptonizing power it is superior to ordinary animal pepsin, having the peculiar additional advantage of requiring neither the aid of an acid nor an alkali to convert the contents of the stomach into peptone.

Chemical Properties.—Tough or fresh meat of any kind dipped in water containing a few drops of the juice, or boiled in water impregnated with the juice, will become in a few minutes quite tender. A simple way to prepare meat is to wrap it in the leaves of the papaya and then roast it. In a tropical climate like India, meat requires to be cooked quickly in order to prevent rapid decomposition, and consequently is usually found tough. I have repeatedly seen my native Hindoo cook, on returning from market, roll the fresh meat or recently killed fowl in a papaya leaf, where it would remain for a few hours before cooking, thus rendering the meat perfectly tender.

Cosmetic.—The juice is used as a cosmetic to destroy freckles on the skin caused by the sun's heat, and to remove ink stains from the hands.

Vermifuge.—The milky juice is an excellent vermifuge. The natives repeatedly use it for children, a single dose, they claim, being sufficient for the cure.

Emmenagogue.—The unripe fruit possesses ecbolic properties, and is often resorted to by native women for that purpose.

Other Medicinal Properties.—The green fruit cooked as a vegetable and the ripe fruit eaten as a dessert seem to have about the same effect as a good digestive and are most effective in cases of dyspepsia and habitual constipation. To my personal knowledge, since coming to India, a chronic case of dyspepsia of several years' standing has been at once relieved and finally practically cured the person eating daily (or as often as the fruit could be so obtained) at the morning or noon meal ripe papaya as a dessert, seasoned only with salt.

The fruit and juice have several other medical properties that have long been recognized by the Hindoo pundit and lately have been receiving the attention of chemists and the medical profession.

The papaya tree grows luxuriantly in southern Florida and in all our insular possessions. Papain may be prepared in many different forms and styles. The green fruit can be pickled or preserved and the ripe fruit cured, canned or dried and powdered.—Wm. Thos. Fee, Consul at Bombay.

Artificial Flowers in Saxony.—Artificial flowers, leaves, and plants form the most important article of export to the United States from this consular district. Several large factories in Dresden produce a considerable quantity, but the principal point of manufacture is at Sebnitz, a town of 8,500 inhabitants 35 miles northeast from Dresden, close to the Bohemian boundary. The declared exports to the United States testify to the remarkable growth and development of this industry; in 1891 they amounted to $97,037.61, and in 1900 to $335,855.19, an increase of $238,817.58 in nine years.

For the fiscal year ended June 30, 1901, there was a slight decrease from the figures of 1900, but the first five months of the current fiscal year promise an increase over the largest annual shipment. From July 1, 1900, to December 1, 1900, the exports amounted to $118,370, while during the same period of this year the figures stand at $188,860.

The origin of the artificial flower industry, according to the most reliable statistics, dates back to about 1840, and was due to the immigration of a few makers of flowers from Bohemia. At first only a very inferior grade was made, chiefly of tissue and thin colored paper.

In time the industry made progress, and business connections were effected with foreign countries. Sebnitz is now not only the center of the artificial flower trade in Germany, but favorably competes with its French rivals.

While it is admitted that the Paris finish and especially the exquisite French taste cannot be excelled, yet Sebnitz places every year a very handsome selection of high-class novelties before the buyer.

Up to the year 1870 very little export business was done from Sebnitz, but the Franco-German war, disastrous to most branches of trade, was directly beneficial to the flower industry. During the siege Paris could not fill orders and Sebnitz was called upon to supply the demand. This gave a remarkable impetus to its trade.

At the present date there are some 430 manufacturers of artificial flowers, leaves, plants, fruits, etc., in this consular district, of which 330 are located in Sebnitz and neighboring villages and 100 in Dresden and suburbs. Of these concerns about one-third are engaged in the wholesale export business, and the largest manufacturers employ from 250 to 1,000 persons.

The total number of persons engaged in the trade is estimated at 10,000, the larger proportion being females.

The total export from Sebnitz to foreign countries, other than to the United States, is said to be over $1,000,000 per annum, and during winter—the busiest time—several thousand large packing cases are dispatched per month.

Practically no machinery is used in the manufacture of artificial flowers, and when going through the largest factory I noticed only hand presses to cut out, emboss and give shape to the leaf or blossom; also, quite an ingenious device for making cotton fruits, and a "tubing" machine, which makes flower and leaf stems of all shades. All the rest of the work, such as dyeing, coloring, stemming, shaping, shading, mounting, waxing, binding, etc., is done by hand.

Work is paid for by the piece—dozen or gross—and the earnings vary from 30 to 50 marks ($7.50 to $12.50) per month for females and from 35 to 80 marks ($8.75 to $20) for males, according to age, kind of work, skill, and diligence.

Children under 14 years of age are prohibited by law from engaging at work in factories, and must have passed the term at the public school before they can obtain such permission.

The most important feature of the artificial flower trade is the house industry, and it can safely be stated that two-thirds of the work is done outside of the factories by families who are supplied with the cut material ready for stemming, shaping, binding, etc. A factory employing 100 persons in its establishment gives work to 300 or 400 outside. There is hardly a house in Sebnitz and neighborhood where artificial flowers are not made, and even the farmer who works in his field in summer time makes flowers during the winter.

The tools used for cutting out the different shapes of leaves, parts of blossoms, etc., are made in Sebnitz and Dresden, and the largest manufacturer has over 500 different tools, some of which, especially those for cutting out fine fern leaves, cost as much as $25 each.—Charles L. Cole, Consul-General at Dresden.

Catalogues and Samples Requested for Peru.—I am in receipt of the following letter, dated January 11, 1902, from Eduardo Higginson, the Peruvian consul at this port:

I take pleasure in addressing you to request your attention to the inclosed notices, which have been sent me by the national societies of agriculture and mining of Lima. They state that bureaus of information have been established at Lima, and request catalogues, price lists, circulars, and small samples relating to machinery, implements, and light goods, to enable the members of both societies to select modern goods for developing the agricultural and mining industries; therefore, I beg you to make these facts known to your government, so that the enterprising manufacturers and merchants of the United States will send to Peru the catalogues, etc., required.

The addresses are: La Sociedad Nacional de Agricultura, Lima, Peru; La Sociedad Nacional de Mineria, Lima, Peru.

I may mention here that the chief industries in Peru are:

Agriculture.—Sugar cane, cotton, wool, rice, vines, cattle, coffee, cocoa, coca, olives, potatoes, silkworms, and cereals.

Mining.—Gold, silver, copper, petroleum, quicksilver, borax, salt, coal, sulphur, etc.

In an interview with Mr. Higginson, since the receipt of his letter, I learn that these societies have duties beyond those of our boards of trade and chambers of commerce. They study the catalogues of machinery to find what is best adapted to the use of Peru, and on their recommendations the government or the people purchase. I inclose copies of the requests of the two societies.—John E. Hopley, Consul at Southampton.

Proposed Electric Railroad in Sweden.—The problem of employing electric power instead of steam for railroads receives more and more attention in Sweden. It is stated that the managers of the State railroads are making investigations in this direction, and a recent newspaper article announces that private concerns are also interested in the matter. A Gothenburg newspaper reports that the board of managers for the Falun-Vesterdalarnes Railroad Company has sent to the government a petition for the gradual adoption of electric locomotives, instead of steam engines, throughout the whole country, and the utilization of water power. The petition mentions that a machine firm in Switzerland has made a proposition to use the Huber system, by which an electric current can be generated when a train passes down inclines, which current can be utilized by other trains on the same road. The Swiss firm proposes to furnish the necessary rolling stock, a Swedish company will supply the electric power, and the railroad company is to furnish railroad lines for the experiment. But cash is still needed for the building of transformers, for raising the current to 16,000 volts and changing the same from three-phase current to two-phase, for electric connection of the rails, etc., all of which it is estimated will cost 100,000 kroner ($26,800). The petitioners ask the government to furnish the money needed.—Robert S. S. Bergh, Consul at Gothenburg.

German Artificial Clay.—Artificial clay, according to German papers, is receiving increased attention abroad. This ceramic novelty, which is used for the manufacture of artificial stone, tiles, gutters, etc., is composed of sand, chalk, cement, liquid glue, and petroleum. The substances are mixed in certain quantities and a claylike mass results, which can be formed at pleasure and acquires an excellent degree of hardness by being subjected to heat.

This artificial clay can be employed in a variety of structures; tiles of different forms and sizes are made of it. They have a perfectly even surface and sharp edges, are fireproof, and resist the influences of the weather; they furthermore absorb no moisture.

The clay is also used for the manufacture of artificial stone in all colors. Tests with this clay have been made at the laboratory of the Technical Experimental Station at Charlottenburg, and the results have been pronounced very favorable.

As the substances are easily mixed without the aid of machinery, the smallest builder can use the process and so obtain structural decorations at a low price.—Richard Guenther, Consul-General at Frankfort.

German Request for Catalogues of Building Material.—Consul-General Guenther, of Frankfort, says that the Social Museum, established by the Society for the Improvement of Workingmen's Dwellings, of which Dr. Phil. Stein, Boersenstrasse 1, that city, is the secretary, desires catalogues and price lists, and samples if possible, of American building material—such as plumbers' supplies, sashes, doors, blinds, ironwork, etc. Communications should be addressed to the secretary.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1267. February 17.—New French Ship-Subsidy Bill.

No. 1268. February 18.—Passenger Traffic between Europe and the United States—Direct Exportation to Southern France—*Opening for Coal in Germany—Labor Disturbances in Chile—Production of Belgian Coal, Iron, and Steel in 1901—Exposition of Sportsmanship at St. Petersburg—German Tariff on Paper.

No. 1269. February 18.—Our Foreign Commerce in 1901.

No. 1270. February 19.—The Iron Industries of Germany—Dredger Wanted for Patras, Greece—Russian Trade in 1901—French Candy Industry—Sealing Ships' Stores in Australia—Excise Dues on Salt in the Netherlands.

No. 1271. February 20.—Manufacture of Afridi-Wax Cloth and Roghan in India—Method of Killing Animals at Paris Pound—Congress for the Relief of the Blind in Brussels—Education in Spain—Sugar Industry of Santo Domingo.

No. 1272. February 21.—Railways in Siam—Harbor Works at Syra—American Coal in Greece—Electricity for Swiss Railways—Milk Flour in Sweden—German Alcohol Production in 1901—Minerals in the Urals.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECIPES.

Directions for Making Chromos.—The production of chromo pictures is by no means difficult, but requires a little skill. Some practice is necessary to obtain good results and one should not become discouraged by a few failures, which no beginner is spared. The glass plate to be used should be washed off with warm water, then it is laid into a 10 per cent. nitric acid solution; after one hour wash all adhering acid off with clean, cold water, dry with a towel and polish the plate with good alcohol on the inside—hollow side—until no more finger marks or fat streaks are visible, which is best ascertained by breathing on it; the breath should show a uniformly blue surface on the glass.

Now take the unmounted photograph to be colored and coat it with benzine by means of a pad of wadding, but only very softly without pressure, so that the retouching of the picture is not disturbed. Put two tablets of ordinary kitchen gelatine in 250 cubic centimeters of distilled or pure rain water, let soak for an hour and then heat until the gelatine has completely dissolved. This warm solution pour over the polished side of the glass, in such a manner that the liquid is evenly distributed. The best way is to pour the solution on the upper right-hand corner, allowing it to flow into the left-hand corner, from there to the left below and right below, finally letting the superfluous liquid run off. Now take the photo, which has been previously slightly moistened on the back, lay it with the picture side on the gelatine-covered plate, centering it nicely, and press out the gelatine solution in excess with feeble pressure, preferably by means of a rubber squeezer. Care must be taken, however, not to displace the picture in this manipulation, as it is easily spoiled thereby.

It must be borne in mind that the solution must never be allowed to boil, since this would render the gelatine brittle and would result in the picture, after having been finished, cracking off from the glass in a short time. When the picture has been attached to the glass plate in a neat manner without the formation of blisters, which is best controlled from the back, the edge of the glass is cleansed of gelatine, preferably by means of a small sponge and lukewarm water and the plate is allowed to dry over night.

When the picture and the gelatine are perfectly dry, coat the back of the picture a few times with castor oil until it is perfectly transparent; carefully remove the oil without rubbing and proceed with the painting, which is best accomplished with good, not overly thick oil colors. The coloring must, of course, be controlled from the glass side, and for this reason the small details, such as eyes, lips, beard and hair, should first be sketched on. When the first coat is dry the dress and the flesh tints are painted, which does not present the slightest difficulty, since the whole surface may be painted over and it is not necessary to paint shadows, as these are already present in the picture—folds of the dress, modulation of the face—and consequently show the color through in varying strength.

When the coloring is done and has dried, a second glass plate should be laid on for protection, pasting the two edges together with narrow strips of linen.—Diamant.

Hair Washes.—As the name implies, these washes serve for cleansing the scalp of dust and other impurities adhering to it. A large number of them are offered for sale as nostrums and specialties under high-sounding names, although they are often declared to be worthless by experts, some of these remedies being so injurious that their use is not advisable without previous consultation of an expert.

Following are some formulas of hair washes which may be employed without hesitation:

Flower Hair Wash.

Spirit of wine (85 deg.)	1 kilo.
Jasmine pomade extract	100 grammes.
Rose pomade extract	100 grammes.
Tuberose pomade extract	75 grammes.
Vanilla tincture	50 grammes.
Rose water	1 kilo.

Bay Rum.

Tincture of bay leaves	150 grammes.
Bay oil	5 grammes.
Ammonium bicarbonate	30 grammes.
Borax	30 grammes.
Rose water	1,000 grammes.

Dissolve the bay oil in the tincture, the ammonia and the borax in the rose water, mix both solutions and filter.

Eau de Cologne Hair Wash.

Rose water	1,000 grammes.
Glycerine	360 grammes.
Eau de Cologne	300 grammes.
Borax	50 grammes.

Frothing Hair Wash.

Spirit of wine (85 deg.)	500 grammes.
Rose water	1,000 grammes.
Prime white grain soap or transparent soap	30 grammes.

Finely scrape the soap, dissolve it at moderate heat in the spirit of wine and mix with the rose water.—Original recipes of Alwin Engelhardt in Neueste Erfindungen und Erfahrungen.

Directions for Hardening Scissors.—The united legs of the scissors are uniformly heated to a dark cherry red, extending from the point to the screw or rivet hole. This may be done in the naked fire, a feeble current of air being admitted until the steel commences to glow. Then the fire is left to itself and the scissor parts are drawn to and fro in the fire, until all the parts to be hardened show a uniform dark cherry red. The two legs are hardened together in water and then tempered purple-red to violet.

The simultaneous heating, hardening and tempering of the parts belonging together is necessary, so that the degree of heat is the same and the harder part does not cut the softer one.

In accordance with well-known rules, the immersion in the hardening bath should be done with the point first, slowly and vertically up to above the riveting hole.—Metallarbeiter.

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